Man and Environment

CUK-H06316-9-KP2290

Journal of the
Indian Society for
Prehistoric and Quaternary Studies

Volume XXVIII, No. 1 (January–June 2003)

9

Calcutta University Library
ALIPORE
CAMPUS
02/09

Indian Society for Prehistoric and Quaternary Studies

c/o Department of Archaeology
Deccan College
Pune 411 006, India

Executive Committee

Chairman	V.N. Misra
Vice-Chairman	R.C. Agarwal
General Secretary	P.K. Thomas
Joint Secretary	P.P. Joglekar
Assistant Secretary	P.S. Joshi
Treasurer	Arati Deshpande-Mukherjee

934
M 2

Members

S.G. Deo
R.K. Mohanty
Malti Nagar
K. Rajan
R.N. Singh
B.C. Deotare
K. Krishnan
Sunil Gupta
K.S. Saraswat
S.F. Wadia
P.P. Joglekar
Sheila Mishra
Sila Tripati
Sadashiba Pradhan

Membership

Life: South Asia – Rs. 2000/- Other Countries – US $ 300

KP 2290

The subscription amount should be sent to the General Secretary of the Society (but not in his personal name). It should be a Bank Draft payable to the Indian Society for Prehistoric and Quaternary Studies and drawn on any nationalized bank which has a branch in Pune. Money Orders/Postal Orders/Cheques will not be accepted.

Change of address should be immediately communicated to the General Secretary to ensure prompt despatch and safe delivery of the Journal, conference circulars, etc.

Cover: Spearhead from Nagara

Editorial

Like several previous issues of the Journal, readers will find in the present issue articles on diverse subjects and related to diverse geographical areas. Purushottam Singh in his presidential address delivered during the XXX Annual Conference of the Society at Ernakulum in December 2002 has reviewed nearly two decades of his archaeological research in the Middle Ganga Plain. He highlights the importance of palaeoenvironment and emergence of agriculture-based society. Ambika Patel's paper, for which she was given the H.D. Sankalia Young Archaeologist Award, contains a fresh analysis of iron tools collected from various Early Historic sites in Gujarat. Michel Danino has demonstrated the outdated nature of the "Aryan Invasion Theory" and described, with help of many examples, the continuity of Harappan elements into the present-day Indian society.

A.S. Gaur and Sundaresh report the findings of their recent exploration and onshore excavation at Bet Dwarka Island. The paper by Srivastav and others is based on metallurgical analyses carried out on a Chalcolithic copper object from Balathal in Rajasthan. K. Rajan reports the results of his extensive explorations done in Pudukottai region of Tamil Nadu. Such reports are important since they provide a baseline for future archaeological investigations. V.D. Gogte's article dealing with the evidence of Early Historic period at the port site of Chaul is interesting because it reports substantial archaeological finds support of the post. Arun Kumar and S.N. Bajpai's paper deals with cultural aspects of the rituals related to living megalithic tradition in the Bastar district of Chhattisgarh. Such studies are important because they provide us insights for understanding the meaning of archaeological megaliths. Information technology and fast access information tools such as worldwide web are going to be crucial for archaeological research. A.R. Marathe and others provide an example of such a website that allows viewers to find any information Western Indian caves.

Looking at the advantages of the modern informatics and communication tools such as e-mail it is now necessary that our members start using e-mail addresses. Several e-mail portals provide an e-mail account absolutely free. This way of communication is cheaper and faster than other conventional ways of sending letters. The editors feel that those members who already have e-mail addresses should send these to our office as early as possible. Also these members can help others opening e-mail accounts so that in future, members could be reached in a much easier and cheaper way.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR and ASI accept no responsibility for them.

Archaeology of the Middle Ganga Plain*

Purushottam Singh

Department of Ancient Indian History, Culture and Archaeology
Banaras Hindu University
Varanasi 221 005

I am deeply beholden to the Executive Committee of the Indian Society for Prehistoric and Quaternary Studies for electing me President of its session being hosted by one of the promising institutions of India, namely, the State Institute of Archaeology, Art History, Conservation and Museology, Ernakulam. This is indeed a singular honour but I do not know if I would be able to rise to the occasion.

It has been customary on occasions like this to summarise and highlight the discoveries made since the last Conference. I propose to deviate from this custom mainly because most of the researchers are present here and, I am sure, they are going to exchange notes. I propose to take you to a limited but culturally rich part of India, the Middle Ganga Plain, with which I have been familiar and where I have spent nearly two decades in the field. I have presented the discoveries made till 1996 to another galaxy of scholars at Chennai (Singh 1996). Here I shall confine my observations to the discoveries made since 1996.

The Middle Ganga Plain stretches for about 300 km from the Himalayan foothills in the north to the Vindhyan range in the south. It attained its present form during the Post-Tertiary period when this deep trough was filled up by fine alluvium brought down by the rivers from the Himalayas in the north. In Prehistoric times the main river Ganga, watered by several tributaries flowed sluggishly in a meandering fashion forming ox-bow lakes, some of which are perennial. These lakes were rich in aquatic fauna and the lands around them were covered with wild grasses, many of which had edible grains. With the onset of milder climate in the Holocene, the marshy land gradually turned into good grassland, which attracted both large and small animals.

Historically, the middle Ganga valley has been a meeting ground of three major linguistic-cultural streams of the country, namely, the Indo-Aryan, Dravidian and Austro-Asiatic. The bulk of the population, especially of the Ganga valley, speaks languages derived from Sanskrit, like Hindi, Oriya, and Bengali. However, some of the tribal communities like the Gonds of southern Uttar Pradesh, Madhya Pradesh, Bihar and Orissa and the Oraons of Chhota Nagpur plateau of Jharkhand and West Bengal speak Gondi and Kurukh, respectively, which belong to the Dravadian family. Other tribes like the Kols, Musahars and Korwas of southern Uttar Pradesh, the Mundas and Santhals of Bihar, Orissa and West Bengal and the Gadabas, Saoras and Bondos of Orissa speak languages belonging to the Austro-Asiatic family (Misra 2001: 508-509).

The Middle Ganga Plain has been important in understanding the formative period of Indian culture. In the later Vedic period, with the formation of Kosala and Videha kingdoms, it had become an important administrative unit. The spread of Aryan culture is thoroughly documented in the *Satapatha Brahmana.* It informs us that the king of Videha, Videgh Mathava, accompanied by his priest, Gotama-Rahugana, carried the sacrificial fire from the bank of the Saraswati river eastward across Kosala and the Sadanira river. As the evidence discussed below will demonstrate, the Middle Ganga Plain and the adjoining hills of the Vindhyas in the south witnessed the earliest smelting of iron that heralded a new era of prosperity leading to the rise of the sixteen Mahajanapadas.

Singh (1996) observes that the Ganga plain is a peripheral foreland basin which came into existence in Early Miocene, expanded in the Middle Miocene, and attained its present form in the Late Quaternary. The stage-wise evolution of the Ganga plain took place in response to the thrust-fold belt loading events in the Himalaya and consequent southward expansion of the basin. The main rivers of the Ganga plain, mainly the Ganga, Yamuna, Gomati and Ghaghara show very wide valleys in which the present-day active channel and its flood plain is entrenched. They are the areas of sand deposition in the Ganga plain. Singh (1996: 129) observes that the residence time of these main rivers in their valleys is of the order of 10^3-10^5 years during which several climatic and base level changes transformed the character of the river channels, and the nature of sediment.

---

* Presidential Address delivered during the XXX Annual Conference of the Indian Society for Prehistoric and Quaternary Studies held at the State Institute of Archaeology, Art History, Conservation and Museology, Ernakulum, Kerala on 9 to 22 December 2002.

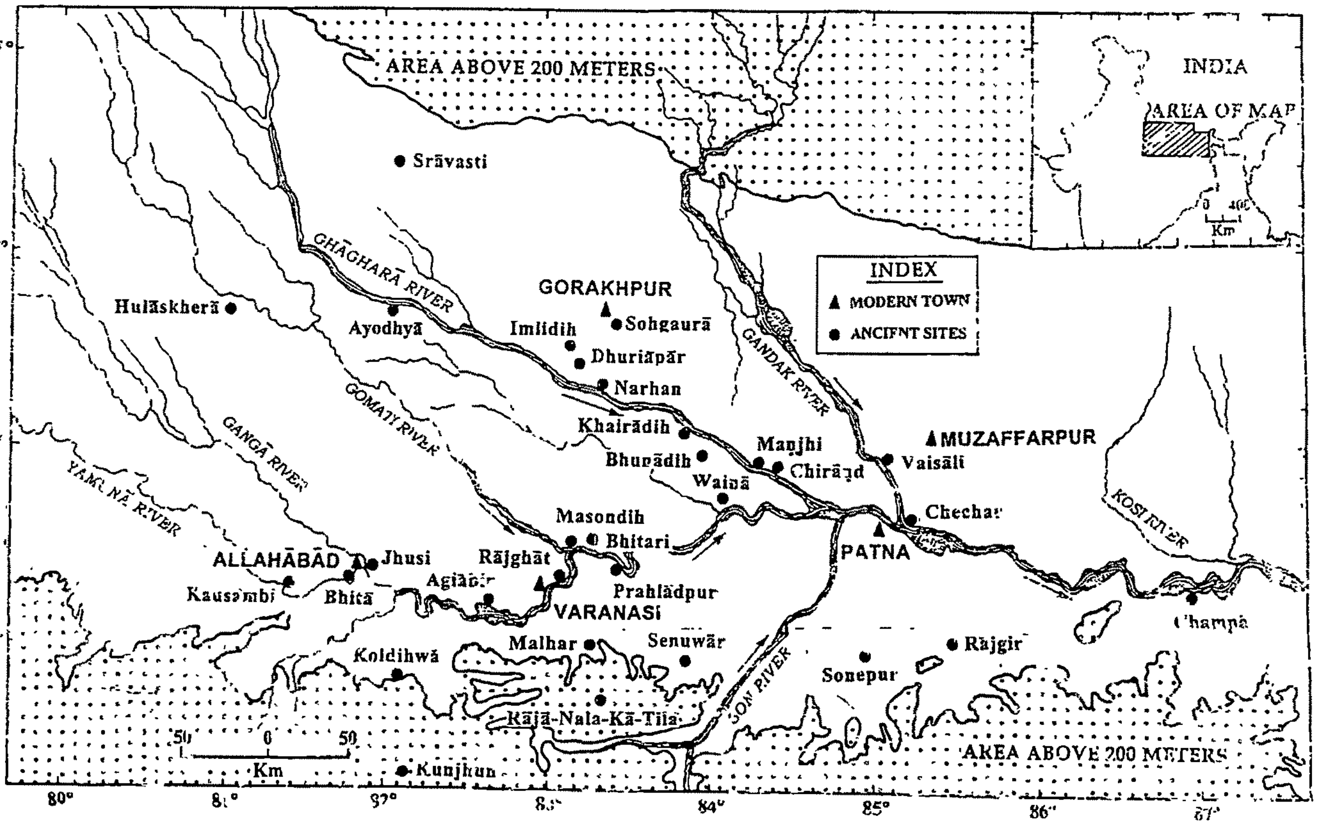


Fig. 1: Archaeological sites in Middle Ganga plain

Traces of the earliest human occupation of the middle Ganga plain have been obtained from a cliff section at Kalpi, district Jalaun, located on the southern bank of the Yamuna river. The cliff section at this place has been under study (Singh *et al.* 1999). It is about 20 m thick and can be traced laterally for several hundred metres. A stratigraphic horizon in this cliff has yielded rich vertebrate fossils comprising an elephant tusk, shouldered blade of elephant, molars of *Equus* and bovids, etc. along with fragments of bones showing definite evidence of human workmanship. Human femurs with unique pencil sharpening are also found in the Yamuna bed. This horizon represents deposit of humid climate around 45 Ka, and is affected by an intense seismic event. Lithic and bone artefacts, chronologically assignable to the Middle Palaeolithic period have been obtained. The lithic artefacts comprise pebble tools, cores, unretouched pebbles, atypical points, side scrapers and chips. The bone artefacts include end-scraper, point, notched tool, burin, atypical end scraper and bones with cut marks (Tewari *et al.* 2002b). This tool-bearing horizon has been dated by Infrared Stimulated Luminescence (IRSL) technique to around 45 Ka. This is the first record of Middle Palaeolithic human occupation of the Ganga Plain. Further fieldwork at Kalpi is currently under progress and is likely to produce interesting results (personal communication: Rakesh Tewari).

A subsequent colonisation of the Middle Ganga Plain was done by the Mesolithic people. Traces of Mesolithic culture have been found on nearly 200 sites in the plain and about 300 sites in the Vindhyas (Misra 1997). The Mesolithic people of the Vindhyas made forays in this region in search of plant foods on the banks of the Ganga and near horse-shoe lakes, Intensive field work carried out by scholars of the University of Allahabad has brought to light a large number of sites of this culture spread over in Allahabad, Varanasi, Pratapgarh, Jaunpur and Sultanpur districts. The three excavated sites of this culture - Sarai Nahar Rai, Mahadaha and Warikalan-Damdama are situated in the Pratapgarh district. The salient features of this culture are as follows:

The thickness of the occupational deposits at these sites ranges from 6 to 1.5 m indicating that these settlements were regular habitational sites for a considerable period of time rather than seasonal camps as believed earlier. Traces of the habitation of Mesolithic people comprised a burnt floor at Sarai Nahar Rai that has been interpreted as a community hearth. Semi-circular burnt plaster floors and regular hearths have been exposed at Warikalan-Damdama. These hearths yielded burnt clay lumps and charred animal bones, suggesting that these animals were hunted and consumed by the Mesolithic people, and their flesh was roasted in open fires. Their artefact inventory comprises microliths and debitage, plenty of sandstone fragments and other raw materials brought from the Vindhyan region. Fragments of querns, mullers, hammerstones, etc. fashioned on sandstone, quartzite and basalt have been reported. This indicates that the Mesolithic people used to collect wild seeds, edible roots, etc. for supplementing their dietary items. In this context the occurrence of wild rice from the late Mesolithic phase at Chopani Mando assumes considerable importance. The single radiocarbon date from Sarai Nahar Rai reads 8395 ± 110 B.C. Two AMS ^{14}C dates from Damdama read 6690 ± 65 B.C. and 6915 ± 65 B.C., respectively. These dates suggest the beginning of the Mesolithic culture in the early Holocene period (Misra 1997: 37).

Here it is worthwhile to recall that Carlleyle had found a Mesolithic core at the base of his sequence at Joharganj on the northern bank of the Ganga way back in 1885. A parallel-sided blade of chert with ochrous red ware was found by us in 1964 in trial digging of Kamauli, located on the left bank of the Ganga, about 4 km downstream of Varanasi. The occurrence of microlithic flakes of quartz at sites like Susipar and Puraina Tal has led Chakrabarti (2001: 228) to remark that the presence of a Mesolithic substratum in the Sarayupar plain is not impossibility.

The Neolithic Interlude

The breeding of selected animals (dog, cattle, sheep and goat) and the cultivation of selected wild grasses and cereals (barley, wheat, rice, etc.) generated surplus food and brought significant changes in the way of life of prehistoric man. This transition from hunting-gathering to food production has been aptly designated as the Neolithic Revolution (Childe 1936). Traces of Neolithic culture in the Vindhyas were documented by the excavation of Koldihwa and Mahagara (Sharma *et al.* 1980) and their extension in the Ganga valley was suspected in the earliest level of Sohgaura (Chaturvedi 1985: 101-108). Although a solitary stone celt was found in the lowest level at Narhan, the hallmark of this culture, the corded red ware pottery was missing at this site. This was subsequently discovered and documented in our excavations at Imlidih Khurd in 1992-1995 (Singh *et al.* 1992, 1993, 1994). The recent excavations at Lahuradeva have not only substantiated our observations at Imlidih Khurd but have added significantly to the understanding of this culture (Tewari *et al.* 2002a: 54-62). The results of the excavations conducted at this site in 2001-2002 are as follows.

Lahuradeva is situated in district Sant Kabir Nagar of eastern Uttar Pradesh. The ancient settlement measures 220 m (east-west), and 140 m (north-south) and has an elevation of four metres from the surrounding levels. A lake surrounds it from three sides. The abundant aquatic fauna attracted the Neolithic man to settle here in around 5000 B.C. The excavation conducted by the U.P. State Archaeology Department in 2001-2002 has brought to light a sequence of cultures from the Neolithic to the end of the Kushana Period. This culture sequence has been divided into five periods, the earliest of which has been further sub-divided into sub-Periods IA and IB.

The ceramic industries of Period IA comprise cord-impressed red ware and Black-and-Red ware. In both the wares the pots are mostly handmade but some of them are also wheel made. The small burnt clay nodules present in this sub period indicate that the inhabitants lived in wattle-and-daub houses. The carbonised material obtained from this sub period was analysed by K.S. Saraswat of the Birbal Sahani Institute of Palaeobotany, Lucknow. His analysis shows the presence of grains of cultivated rice along with a few wild grasses. Further, husk marks of rice were found embedded in the core of a number of potsherds. There are two radiocarbon dates which read as follows:

1. BS-1951: BP 5320 ± 90 (Cal. B.C. 4220, 4196, 4161)
2. BS-1966: BP 6290 ± 160 (Cal. B.C. 5298)

The above dates indicate that the earliest human activities of Period I at Lahuradeva may be placed in the late sixth and fifth millennium B.C.

Period IB continues with the tradition of earlier phase, i.e. a coarse variety of red ware and Black-and-Red ware. The Black-and-red ware witnessed quality improvement and the appearance of linear designs painted in cream-white colour. There are two radiocarbon dates from this sub period, of which one (BS-1938), is not reliable but the other one (BS-1950) reads 3750 ± 90 BP (Cal. B.C. 2135, 2079, 2056).

Period II is characterised by the appearance of Black-and-Red ware in a considerable proportion, painted potteries and copper objects. The second season's work at Lahuradeva is currently under progress and we can expect interesting results in the coming months. The limited evidence obtained so far from this site has given a repertoire of antiquities of Neolithic culture as also a respectable antiquity to cultivation of rice.

Another Neolithic settlement excavated in the year 2000 is Tokwa, located at a distance of 51 km southwest from Mirzapur. It is situated on the confluence of Belan and Adwa rivers. The Neolithic culture at this site comprised cord-impressed pottery and rusticated ware. The artefact inventory comprises querns, mullers, hammerstones and microliths of semi-precious stones and bone arrowheads. The grains obtained by flotation include rice, barley, *til,* and *moong* (Misra *et al.* 2001: 227). The structural activity comprises circular/semi-circular wattle-and-daub structures. Tokwa is a very extensive and well-preserved site and its sustained excavation over a number of years is likely to unfold many aspects of the Vindhyan Neolithic culture.

The next developmental phase is marked by the Chalcolithic culture in the Vindhyas and Narhan culture in the Sarayupar plain. Excavations at Khairadih, Sohgaura, Imlidih Khurd, Chirand, Chechar and other sites provide evidence pertaining to the transitional stage between the preceding Neolithic and Chalcolithic cultures of this region. More than two dozen sites of the Narhan culture have been excavated and their results have been summarised by several scholars. At least three stages of development have been delineated by Misra (2000: 75). Without going into details of each stage, it can be observed that in the absence of any lithic component it is not appropriate to name this culture Chalcolithic. The inhabitants of Narhan culture used Black-and-Red ware that accounts for 58% of the total ceramic range. About 20% of the total ceramic assemblage is painted. The identity of the Narhan culture has now been firmly established by the discovery of a large number of sites with clear assemblage of this culture. In order to check the stratigraphic position of this culture, we have studied a few key sites like Dhuriapar, Waina, Bhunadih, Imlidih Khurd and Agiabir during the last decade (between 1989-2001).

Among the recently excavated sites mention may be made of Raja Nal Ka Tila, Malhar, Jhusi and Agiabir. Raja Nal Ka Tila and Malhar are both situated on the Karamnasa river in district Sonbhadra and Chandauli, respectively (Tewari 2001; Tewari and Srivastava 1997, 1998). Both sites have yielded a four-fold culture sequence termed as pre-iron, early iron, NBPW and Kushana-Gupta cultures. The most outstanding contribution of these two sites is the dating of early iron. On the basis of radiocarbon dates from Raja Nal Ka Tila, the antiquity of iron has been pushed back to 1300 B.C. Partly confirmatory evidence of this nature comes from Jhusi near Allahabad where the antiquity of iron goes back to 1100 B.C. (Misra *et al.* 2000: 23-30). But the radiocarbon dates from Malhar point to a still earlier date and the excavator of Malhar suspects that it can be taken to about 1600 B.C., if not earlier. The presence of a good quantity of iron slag at Malhar as also at the nearby site of Lohsanwa is significant and the presence of earthen furnaces within the heaps of iron slag along with terracotta pipe struck with smelted iron provide ample evidence for understanding the process of iron smelting in this region.

We discovered the protohistoric settlement of Agiabir in 1998 and excavated it for three field seasons (1999-2001). This settlement is located on the left bank of the Ganga in district Mirzapur, and extends over an area of more than a kilometre along the river. The excavation resulted in the discovery of an uninterrupted sequence from the Narhan culture to post-Gupta period (Singh 1999; Singh and Singh 2000, 2002a,b).

The earliest inhabitants belong to the Narhan culture. They lived in wattle-and-daub houses. Fragments of burnt clay with reed marks and patches of floors, ovens and post-holes have been found. A bead-manufacturing workshop is an important discovery of this period. A good number of finished and unfinished beads together with stone chips were recovered from this workshop. This tradition of bead making continued in the subsequent two periods as well. It would thus be logical to conclude that bead manufacturing was an important industry and the manufactured beads were exported to other contemporary settlements, besides catering to the aesthetic needs of the local inhabitants. Other antiquities comprise bone points, beads of terracotta, pottery discs and a copper fish hook.

The main ceramic industries of this period comprise Black-and-Red ware (mostly medium and coarse fabrics), Black-slipped ware (in a limited quantity but in fine fabric) and Red ware. A few sherds of Black-and-Red ware and Black-slipped ware bear linear paintings in white as in the case of Narhan.

The inhabitants of Period II also continued to live in wattle-and-daub houses. This period is marked by Black-slipped ware and Red ware but total absence of Black-and-Red ware. The inhabitants used iron for the first time in this period.

As in the preceding period, the inhabitants of Period III also lived in wattle-and-daub houses. The main ceramic industries of this period are Black-slipped ware, NBPW, Grey ware and Red ware. The most important discovery of this period is a cache of copper and iron objects found *in situ* in a room. The copper objects include three vases, two carinated *handis,* one lid-like object, one *lota*-shaped vessel, two bowls and a mirror. All these objects except the *lota* were placed upside down at a depth of 6.60 m below datum. The iron objects include two swords and a 1.07 m long lamp stand. Such a cache of vessels and implements has not been reported so far from any other NBP site in the middle Ganga valley. The site continued to remain under occupation in the Sunga-Kushana, Gupta and Post-Gupta periods. A complete sealing of baked clay bearing the legend '*Harisenasya*' shows intimate contact of this site with Rajghat (ancient Varanasi) as several hundred sealings of this trader were recovered from the latter site (Narain and Roy 1977).

Palaeoenvironment and the Rise of Agriculture

Environmental factors, including behaviour of rivers and lakes, climate and accessibility of natural resources, were largely responsible for the growth, maturity and expansion of the Neolithic and Chalcolithic cultures. Palaeoenvironmental studies in the Ganga plain are in infancy. Way back in 1976 H.P. Gupta had constructed a pollen sequence from an oxbow lake in Pratapgarh district. It is in the vicinity of sites which may have played a role in the development of agriculture in the mid Ganga plain (Sharma *et al.* 1980; Possehl 1999: 265). Gupta has grouped the climatic sequence, as determined from the biostratigraphy of the lake basin, into four phases (I-IV). The gradual vegetation pattern is rather uniform and is tripped more towards open savannah forest with vast stretches of grasslands and a few scattered stands of arboreal vegetation (Gupta 1976: 115).

As regards the origin of agriculture in the mid-Ganga plain, K.S. Saraswat of the Birbal Sahani Institute of Palaeobotany, Lucknow made pioneering effort. His studies have shown that the Narhan culture people cultivated two crops a year. Grains of hulled and six-rowed barley, three varieties of wheat, rice, pea, green gram, chickpea, *khesari* and mustard were cultivated. This practice was followed by their predecessors, the pre-Narhan people, at Imlidih Khurd. Evidence for the cultivation of rice, barley and bread wheat, lentil, field pea, grass pea, horse gram and oilseeds comprising linseed and *til* has been obtained (personal communication: K.S. Saraswat). More recently, evidence for the cultivation of rice in the Neolithic context has been obtained from Lahuradeva. This provides confirmatory evidence to the one coming from Koldihwa, that rice was cultivated in this region from about 5000 B.C.

The find of lichen (*Everniastrum cirrhatum*) from the cultural stratum datable between 1300 and 800 B.C. at Imlidih Khurd, is significant to decipher its use as an ingredient of spices and medicine. Vernacularly known as '*Chharila*', it occurs on the bark of trees in the temperate forests of the Himalayas, at an elevation of 1000-4000 m. The use of '*Putranjeeva*' (*Drypetes roxburghii)* nuts is also evidenced in the cultural lexicon at the same site and the name signifies the stones of the fruit being worn as necklaces by children to ward off any harm and for longevity. A few nuts with holes made in them suggest that they had been strung as necklace. It is a unique evidence of a definite aspect of human occult belief and activity (Saraswat 2001).

References

Chakrabarti, D.K. 2001. *Archaeological Geography of the Ganga Plain.* Delhi: Permanent Black.

Chaturvedi, S.N. 1985. Advances of Vindhyan Neolithic and Chalcolithic Cultures to the Himalayan Tarai, *Man and Environment* IX: 101-108.

Misra, B.B. 2000. A Chalcolithic Culture of the Northern Vindhyas and the Mid-Ganga Valley, in *Peeping Through the Past* (S.C. Bhattacharya, V.D. Misra, J.N. Pandey and J.N. Pal Eds.), pp. 66-85. Allahabad: Allahabad University.

Misra, V.D. 1997. The Mesolithic Cultures of the Vindhyas and the Ganga Valley with Special Reference to Environment and Chronology, in *Him-Kanti* (B.M. Khanduri and Vinod Nautiyal Eds.), pp. 32-38. Delhi: Book India Publishing Company.

Misra, V.D., B.B. Misra and J.N. Pandey 1996. A Preliminary Report of Excavations at Jhusi, District Allahabad (UP), *Pragdhara* 6: 63-66.

Misra, V.D., B.B. Misra and J.N. Pandey 1998. Further Excavations at Jhusi, District Allahabad (UP), *Pragdhara* 9: 43-49.

Misra, V.D. B.B. Misra, J.N. Pal and M.C. Gupta 2000. Explorations at Tokwa: A Neolithic-Chalcolithic Settlement on the Confluence of Belan and Adwa, in *Peeping Through the Past* (S.C. Bhattacharya, V.D. Misra, J.N. Pandey and J.N. Pal Eds.), pp. 45-57. Allahabad: Allahabad University.

Misra, V.D., J.N. Pal and M.C. Gupta 2001. Mesolithic Cultures of Northern Vindhyas with Special Reference to Tokwa, *Bharati* 25: 211-233.

Misra, V.N. 2001. Prehistoric Human Colonisation of India, *Journal of Bioscience* 26(4) Supplement: 491-531.

Narain, A.K. and T.N. Roy 1977. *Excavations at Rajghat* Part III. Varanas: Banaras Hindu University.

Possehl, Gregory L. 1999. *The Indus Age: The Beginnings.* New Delhi: Oxford-IBH.

Sharma, G.R., V.D. Misra, D. Mandal, B.B. Misra and J.N. Pal 1980. *Beginning of Agriculture.* Allahabad: Abinash Prakashan.

Saraswat, K.S. 2001. Research Findings, *Newsletter of the Birbal Sahni Institute of Palaeobotany* June 2001: 4.

Singh, A.K. 1999. Explorations at Agiabir, District Mirzapur (U.P.), *Pragdhara* 9: 51-56.

Singh, Indra Bir 1996. Geological Evolution of the Ganga Plain-An Overview, *Journal of the Palaentological Society of India* 41: 99-137.

Singh, Indra Bir 2002. Later Quaternary Evolution of Ganga Plain and Proxy Records of Climate Change, Neotectonics and Anthropogenic Activity, *Pragdhara* 12: 1-25.

Singh, Indra Bir, Sulekha Sharma, Mahesh Sharma, Pradeep Srivastava and Govindaraja Rajagopalan 1999. Evidence of Human Occupation and Humid Climate of 30 Ka in the Alluvium of Southern Ganga Plain, *Current Science* 76(7): 1022-1025.

Singh, P. 1992-93. Archaeological Excavations at Imlidih Khurd 1992, *Pragdhara* 3: 21-36.

Singh P. 1993-94. Further Excavations at Imlidih Khurd 1993, *Pragdhara* 4: 41-48.

Singh, P. 1994. *Excavations at Narhan (1984-89).* Varanasi and New Delhi: Banaras Hindu University and B.R. Publishing Corporation.

Singh, P. 1996. Prelude to Urbanisation in the Sarayupar Plain, Presidential Address (Section-V), *The Indian History Congress,* Fifty-Seventh Session, Chennai.

Singh, P. 1999. Agiabir-1999: A Preliminary Report, *Puratattva* 29: 117-119.

Singh, P., A.K. Singh and I.J. Singh 1991-92. Excavations at Imlidih Khurd, *Puratattva* 2: 120-122.

Singh, P. and A.K. Singh 2000. Excavations at Agiabir, District-Mirzapur (UP), *Pragdhara* 10: 31-55.

Singh, P. and A.K. Singh 2001a. Second Season's Excavations at Agiabir, District- Mirzapur (UP), *Puratattva* 31: 157-159.

Singh, P. and A.K. Singh 2001b. A Rare Discovery of Metal Objects from Agiabir, District Mirzapur (UP), *Man and Environment* XXVI (2): 109-115.

Tewari, R. 2001. Antiquity of Iron in South-Eastern Uttar Pradesh, *Bharati* 25: 124-137.

Tewari, R. and R.K. Srivastava 1997. Excavations at Raja Nal Ka Tila (1995-96), District Sonbhadra (UP): Preliminary Observations, *Pragdhara* 7: 77-96.

Tewari, R. and R.K. Srivastava 1998. Excavations at Raja Nal Ka Tila (1996-97), District Sonbhadra (UP): Preliminary Observations, *Pragdhara* 8: 99-105.

Tewari, R., R.K. Srivastava and K.S. Saraswat 2000. Excavations at Malhar, District Chandauli (UP), 1999: A Preliminary Report, *Pragdhara* 10: 69-98.

Tewari, R., R.K. Srivastava and K.K. Singh 2002a. Excavations at Lahuradeva, District Sant Nagar, Uttar Pradesh, *Puratattva* 32: 54-62.

Tewari, R., P.C. Pant, I.B. Singh, S. Sharma, M. Sharma, P. Srivastava, A.K. Singhvi, P.K. Mishra and H.J. Tobschall 2002b. Middle Palaeolithic Human Activity and Palaeoclimate at Kalpi in Yamuna Valley, Ganga Plain, *Man and Environment* 27(2): 1-13.

Iron from Early Historic Gujarat: A Technological Perspective*

Ambika Patel

Department of Archaeology and Ancient History
M.S. University of Baroda
Vadodara 390 002
babcom_265@yahoo.com

Abstract

A study of stratified iron objects from various archaeological excavations and explorations has been attempted here. The iron objects recovered from excavated sites were studied with special emphasis on processes of manufacture and methods of fabrication. The present work incorporates analysis of iron objects from excavations of the Early Historic sites of Nagara, Shamalaji, Devnimori and Timberva. Along with excavated archaeological specimens, contemporary recycled scrap material and a few objects made by tribal people using traditional technology were also analysed. This study aims at the classification of the iron objects from various Early Historic sites, the distribution of these types and an understanding of the methods of production, and fabrication, by the study of the microstructure of the objects. An attempt to trace the developmental stages in the production technology has also been made. It also aims at the evaluation of the chemical composition of the iron objects to understand the nature of iron in terms of purity and alloying elements as well as the study of the traditional contemporary iron working practices.

Introduction

Ancient metal technology stands as one of the greatest achievements of the urban era. Metal artefacts can be studied to infer the metallurgical techniques used in ancient times. The knowledge of metals and metallurgy transformed hunting, pastoralism and primitive agriculture. The discovery and gradual acquisition of mastery over iron was an important step in this transformation. It gave man a very useful metal that could at once achieve adequate hardness and sharpness to meet nearly all requirements in peace and war, thus heralding the onset of what has been called the Iron Age.

Iron (Fe) is one of the most widely used metals in the world and is best known for its use as a high strength structural material and for steel manufacturing. Iron was the last of the basic metals to be used, much after the use of copper, tin, lead and many of their alloys (Chakrabarti 1976). In the Indian subcontinent, archaeological investigations have shown that the metal had come into use sometime at the end of the second millennium B.C. Excavations at Atranjikhera (Gaur 1983) and Hallur (Nagraja Rao 1971) have brought to light iron objects dated to 1100 and 900 B.C., respectively. A plethora of iron objects have been unearthed from several other sites in India reflecting its widespread use from the Early Historic period onwards. Early iron has been reported from pre-NBPW phase along with Black-and-Red Ware in Somnath-III, Nagara-I and Timberva-I in Gujarat.

In Gujarat the Early Historic period has not been subjected to the same vigorous treatment as the Harappan and post-Harappan Chalcolithic periods. Although several Early Historic (600 B.C.-500 A.D.) settlements (Fig. 1) have been excavated in Gujarat, many of these excavations were conducted more than two decades ago. Hence, in terms of methods of excavation, the questions to be answered, the manner of reporting and recording and analysis of artefacts several limitations are felt. Although a lot of material belonging to the Early Historic period of Gujarat is available, the information obtained in terms of understanding Early Historic society, economy, technology is comparatively little. Thus, in view of the inadequacy of the earlier studies, there is an urgent need for a comprehensive re-look at the Early Historic material in a wider perspective.

Metallography is the study of the structural characteristics, i.e. the constitution of a metal or an alloy in relation to its physical and mechanical properties (Garside 1957). Microscopic studies facilitate an adequate understanding of

---

* This paper was presented at XXX Annual Conference of the Indian Society for Prehistoric and Quaternary Studies held at the State Institute of Archaeology, Art History, Conservation and Museology, Ernakulum, Kerala on 9 to 22 December 2002 and was selected for Prof. H.D. Sankalia Young Archaeologist Award

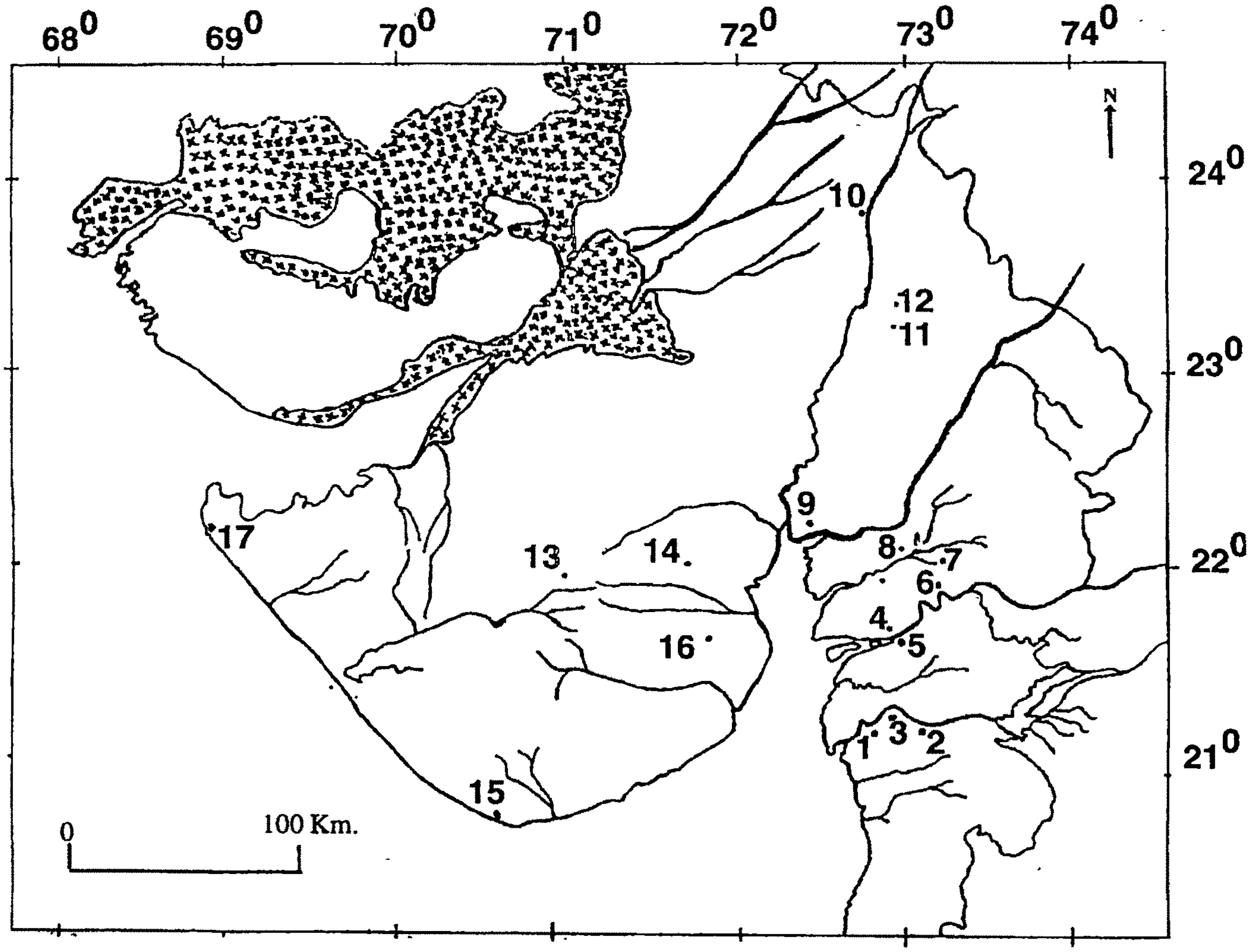


Fig. 1: The excavated Early Historic sites in Gujarat

1. Jokha
2. Dhatva
3. Kamrej
4. Bharuch
5. Nagal
6. Timbarva
7. Karvan
8. Akota
9. Nagara
10. Vadnagar
11. Shamalji
12. Devnimori
13. Amreli
14. Vallabhi
15. Prabhas Patan
16. Padri
17. Dwaraka

various stages of manufacture of the object from the extraction of metal, constitution of metal, fabrication treatment, non-metallic inclusions, extent of corrosion, etc. The microstructure reveals features such as the grain size, grain shape, dendrites, inclusions and matrix constituents. These features are characteristic of the technique of manufacture and indicate the sort of treatment undergone by the object in the hands of the smiths. Hence metallurgy is one such scientific method that helps to study, understand and assess the level of metal technology achieved by the past communities. The understanding of the nature and character of metallurgy of the Early Historic period of Gujarat still remains in its embryonic stage.

Chemical analysis plays a supportive role in drawing inferences about technological aspects. It provides information regarding the constituents of objects and the amount of each component. The nature and proportions of the minor constituents are useful pointers to the source of ores, methods of extraction and working in the case of an unalloyed metal.

Table 1: Iron objects from excavated Early Hitoric sites in Gujarat

	DTV	JKH	TMBR	AKTA	VDNR	SMLJ	DVM	NGR	AMRL	VLB	PRP	DWK	Total
Arrowhead	-	-	1	2	1	-	3	9	2	11	2	1	**32**
Axe	-	-	-	1	-	-	1	-	-	-	-	1	**3**
Bangle	-	-		-	1	1	-	-	-	-	-	-	**2**
Bar	-	-	-	1	-	-	1	-	-	-	-	-	**2**
Bell	-	-	-	-	-	-	-	-	-	1	-	-	**1**
Blade	-	-	3	1	12	-	5	10	-	12	-	1	**44**
Box	-	-	-	-	-	-	-	-	-	1	-	-	**1**
Celt	-	-	-	1	2	1	-	-	-	-	-	-	**4**
Chain	-	-	-	1	-	-	-	-	-	1	-	-	**2**
Chisel	1	-	-	-	1	1	1	2	-	1	-	-	**7**
Dagger	-	-	-	-	-	-	2	2	1	-	-	-	**5**
Disc	-	-	-	-	-	-	-	-	1	-	-	-	**1**
Door chain	-	-	-	-	-	-	-	1	-	1	-	-	**2**
Drill	-	-	-	-	-	-	1	-	-	-	-	-	**1**
Hammer	-	-	-	-	-	-	-	-	-	-	1	-	**1**
Hinge	-	-	-	-	-	-	-	-	-	2	-	-	**2**
Hoe	-	-	-	-	1	-	-	-	-	-	-	-	**1**
Hook	-	-	-	-	2	-	1	2	1	-	1	-	**7**
Horse bit	-	-	-	1	-	-	-	-	-	-	-	-	**1**
Knife	1	-	-	2	3	-	5	4	1	3	-	-	**19**
Laddle	-	-	-	-	1	-	-	-	-	-	-	-	**1**
Miscellaneous	5	-	-	-	-	10	12	-	2	15	16	-	**60**
Nail	4	5	3	6	20	22	340	133	-	87	18	-	**638**
Pick	-	-	-	-	-	-	1	-	-	-	-	-	**1**
Ploughshare	1	-	1	-	-	-	-	-	-	-	-	-	**2**
Ring	-	-	-	1	3	1	2	6	3	1	-	-	**17**
Rivet	-	-	-	-	-	-	-	4	-	-	-	-	**4**
Rod	-	-	-	1	1	-	-	2	-	1	-	-	**5**
Scissors	-	-	-	1	-	-	-	-	-	-	-	-	**1**
Sickle	-	1	-	1	-	1	2	1	1	1	1	1	**9**
Spearhead	-	-	-	1	-	1	2	2	2	2	-	-	**10**
Trowel	-	-	-	-	2	-	-	1	-	8	-	-	**11**
Weight	-	-	-	-	-	-	-	-	-	-	-	1	**1**
Wire	-	-	1	-	1	-	-	-	-	-	-	-	**2**
Total	**12**	**6**	**9**	**21**	**51**	**38**	**379**	**179**	**14**	**148**	**39**	**5**	**901**
Slag	*	*	*	-	*	*	-	*	-	*	*	*	

DTV- Dhatva, JKH- Jokha, TMBR- Timbarva, AKTA- Akota, VDNR- Vadnagar, SMLJ- Shamalaji, DVM- Devnimori, NGR- Nagara, AMRL-Amreli, VLB- Vallabhi, PRP- Prabahs Patan, DWK- Dwaraka
* presnce of slag

Material context

Sites which have yielded iron objects from Early Historic levels (Table 1) are Akota (Subbarao 1953), Amreli (Rao 1966), Bharuch (IAR 1959-60), Devnimori (Mehta and Chowdhary 1966), Dhatva (Mehta and Chowdhary 1975), Dwaraka (Ansari and Mate 1966), Nagal (IAR 1957-58), Nagara (Mehta and Shah 1968), Shamalaji (Mehta and Patel 1967), Prabhas Patan (IAR 1971-72), Timberva (Mehta 1955) and Vallabhi (IAR 1979-80). Of these, Nagara and Devnimori are the well documented and illustrate various aspects of technology of the Early Historic Period. Evidence of iron smelting is reported from Dhatva, Shamalaji, Prabhas Patan and Vallabhi.

Of the total collection from all the above mentioned sites 25 representative cases (Table 2) were chosen for the study on the basis of state of preservation, probable function and over all relevance to the study. They belong to Nagara (Mehta *et al.* 1968) dated between the 5th century B.C. and beginning of the Christian era; Timberva (Mehta 1955), Devnimori (3rd/4th to 7th century A.D.), Shamalaji (Mehta and Patel 1967) dated from 1 to 1000 A.D. For ethnographic study three contemporary scrap metal objects and two tribal arrowheads were chosen.

The typological analysis, metallographic study and chemical analysis were used in the present work. The artefact possesses a set of human imposed attributes that act as an independent variable within a specific artefact system (Clarke 1968). A detailed survey of iron antiquities obtained from stratified context in the Early Historic sites helped to identify type groups, specific types and sub-types. Considering morphology, size, shape, and probable function, the major types studied are, arrowheads, axes, blades, chisels, daggers, knives, nails, rings, spearheads, ploughshare and sickles (Figs. 2-9). The above mentioned artefact assemblage comprise of tools for agriculture, hunting, household activities, warfare and defence, building, craft production, etc. (Table 3). Among the sites surveyed, Devinimori yielded the highest number (379) and variety of iron objects.

Early Historic Metal Technology Tradition

The Early Historic period of Gujarat is divided into two phases — Phase I (400 B.C. to 100 A.D.) and Phase II (100 to 500 A.D.). Iron first occurs in Phase I in association with Black-and-Red ware in pre-NBPW context in Gujarat. In phase II, the slow and gradual acquisition of mastery over iron is seen.

It has been found that majority of the iron objects are heavily corroded leaving hardly any part of the core. The main impurities present in the objects revealed by atomic absorption studies are silica, calcium, manganese, sulphur and phosphorus. These impurities present in the ore might have passed into the metal while smelting. In the early specimens, silica is present. Devnimori specimens showed the absence of silica. The contents of sulphur shows a reduction from Phase I to Phase II. Calcium shows no change in its proportion through time, but a range from 0.01% to 0.1% from Phase I and II (Table 4). The proportion of calcium is not enough to speculate on the use of lime as a flux.

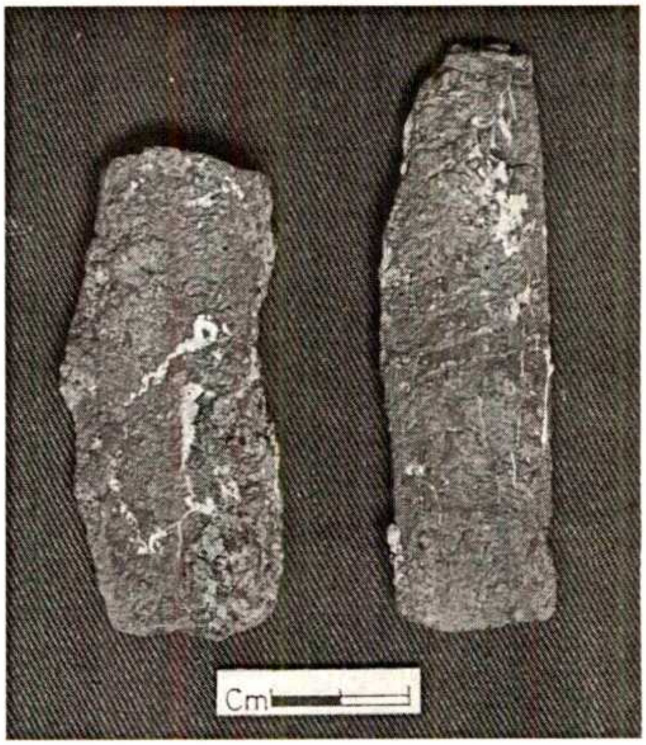


Fig. 2: Broken knives from Nagara

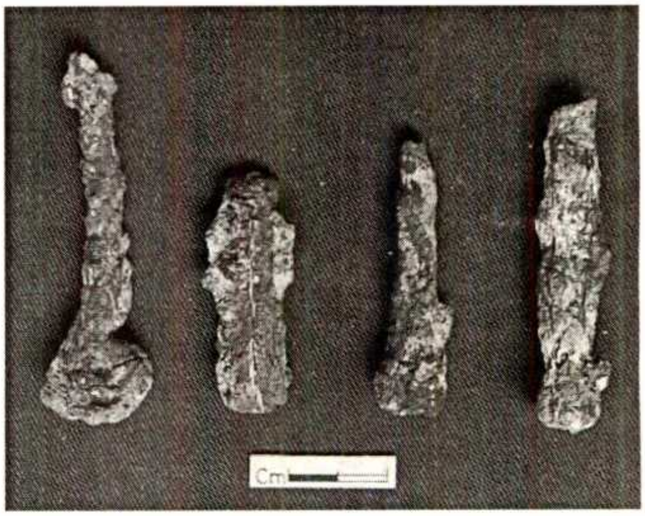


Fig. 3: Nails from Nagara

Table 2: Details of representative samples used in chemical analysis

Sr. No.	Antiquity	Site	District	Period	Weight (gm)	Length (mm)	Width (mm)	Remarks	Reference
1	Arrowhead	Nagara	Kheda	P I					Mehta and Shah (1968)
2	Spearhead	„		P II	58.34	68.57	39.87		„
3	Nail	„	„	„	36,171	53.68	-	featureless head,	„
4	Nail	„	„	„	13.75	52.12	-	featureless head,	„
5	Nail	„	„	„	18.79	73.02	-		„
6	Dagger	„	„	early level, P III	72.25	161.10	32.02max, 11.03min	fish shaped	„
7	Knife	„	„	„	32.91	83.06	23.43	straight back and tapering edge	„
8	Broken blade	„	„	„	0.01	64.94	28.25		„
9	Knife	„	„	„	44.07	85.48	25	with concave blade	„
10	Nail	„	„	late level, P III	22.17	60.17	—	hooked head	„
11	Nail	„	„	middle level, P III	22.54	64.54	—	hooked head,	„
12	Spike	„	„	„	57,294	92.89	22.23		„
13	Nail	„	„	late level, PIII	16.55	62.83			„
14	Handle	„	„	„		89.33	-		„
15	Nail	Timberva	Vadodara	P II	26.39	60.65	16.63		Mehta (1955)
16	Knife	„	„	P III	40.66	107.38	26.94		„
17	Nail	Shamalaji	Sabarkantha	P I	8.57	54.28	7.7		Mehta and Shah (1968)
18	Nail	„	„	„	6.48	52.82	3.82		„
19	Nail	„	„	P II	9.05	89.33	3.1		„
20	Chisel	„	„	P II	46.92	26.56	87.91		„
21	Sickle	„	„	P II	47.02	185.73	15.5		„
22	Broken bangle	„	„	„	14.01	—	—		„
23	Nail	Devnimori	Sabarkantha	P II	17.76	60.36	0.99		Mehta and Chowdhary (1966)
24	Nail	„	„	„	20.25	72.27	2.58		„
25	Nail	„	„	„	42.02	89.59	4.6		„
26	Sickle	Devnimori	Sabarkantha	„	125.28	—	—		„
27	Slag	Dhatwa	Surat	P II	—	—	—		
28	Sheet	Scrap iron			—	—	—		
29	Ankle	Scrap iron			—	—	—		
30	Arrowhead	Tribal			—	—	—		

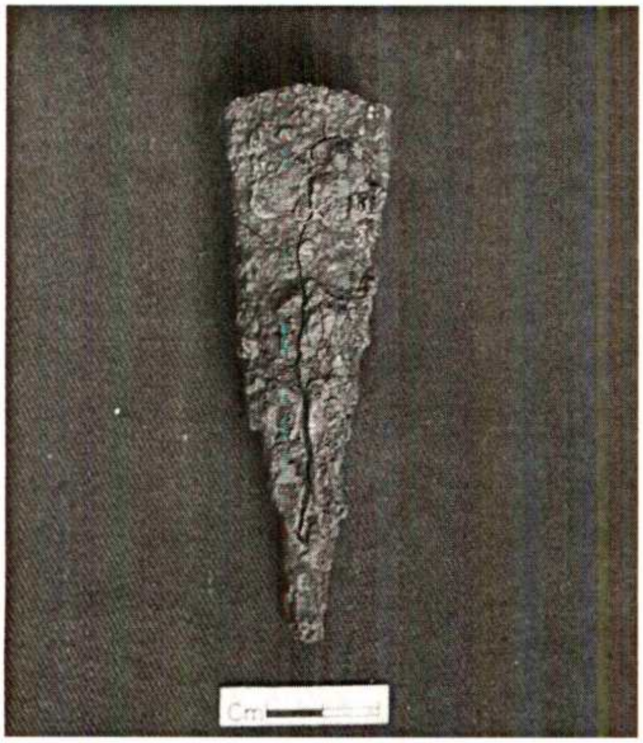


Fig. 4: Chisel from Shamalaji

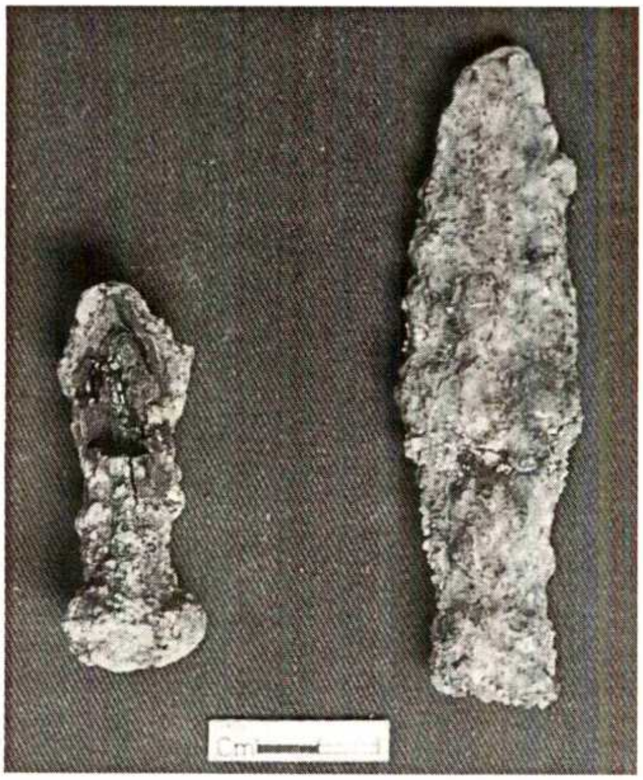


Fig. 5: Nail and knife from Timberva

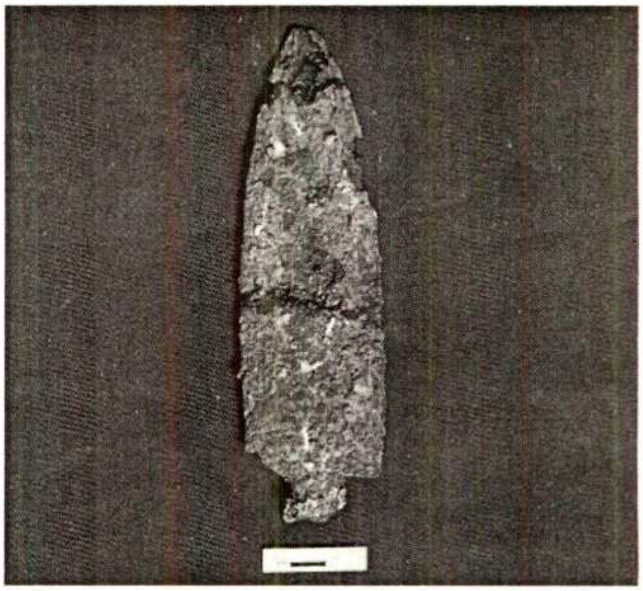


Fig. 6: Spearhead from Nagara

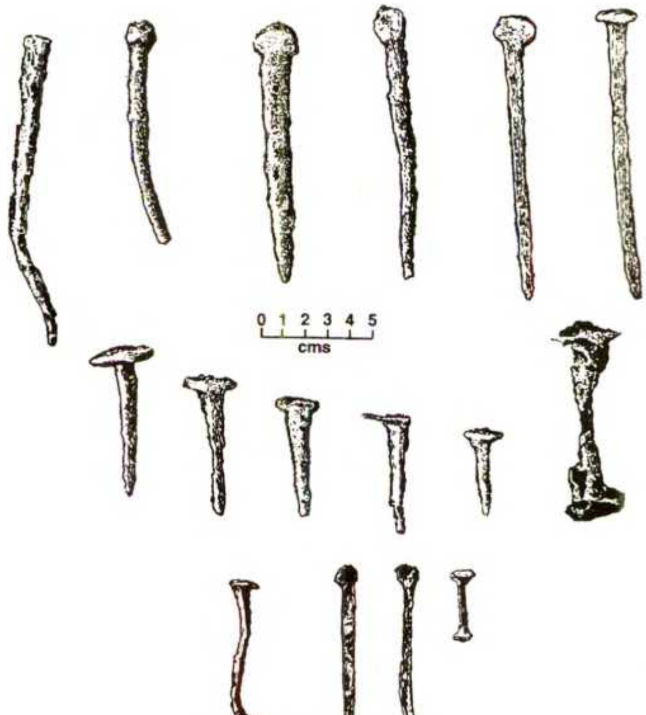


Fig. 7: Nails from Devnimori

Table 3: Various functional types of objects

Type of the Object	Name of the Object	DTV	JKH	TMBR	AKTA	NGR	VDNR	DVM	SMLJ	AMRL	VLB	PRP	DWK
Hunting/War tools	Arrowhead	*	*	1	5	9	1	3	*	2	11	2	1
	Blade	*	*	3	6	10	12	5	*	*	12	*	1
	Dagger	*	*	*	4	5	*	2	*	2	*	*	*
	Horsebit	*	*	*	7	*	*	4	*	*	*	*	*
	Hook	2	*	*	10	2	2	*	*	4	3	*	*
	Spearhead	*	*	*	5	3		2	*	2	2	*	*
	Disc	*	*	*	*	*	*	*	*	*	*	*	*
Agricultural tools	Celt	*	*	*	3	*	2	*	*	*	*	*	*
	Axe	*	*	*	2	*	*	1	*	*	*	*	1
	Sickle	*	1	*	5	2	*	1	1	2	1	1	1
	Ploughshare	1	*	1	*	6	*	6	1	*	1	*	*
	Pick	*	*	*	3	1	*	*	*	*	*	*	*
Household items	Door chain	*	*	*	*	2	*	*	*	*	*	*	*
	Knives	*	1	2	5	4	3	*	3	1	3	2	1
	Doorchain	*	*	*	*	*	*	*	*	*	1	*	*
	Trowel	*	*	*	*	1	2	1	1	1	8	*	1
	Box	*	*	*	*	*	*	*	*	*	*	*	*
	Hinge	*	*	*	6	3	1	*	*	*	2	*	*
	Ladle	*	*	*	*	1	1	*	1	*	*	*	*
Tool for structures	Drillbit	*	*	*	3	4	*	*	2	*	*	*	*
	Nail	*	*	5	15	130	20	133	22	3*	87	18	16
	Rivet	*	*	*	*	*	*	2	*	2	*	2	*
	Bar	*	*	*	*	*	*	*	*	*	*	1	*
	Hammer	*	*	*	2	*	*	*	*	*	*	1	*
Craft activity Tools	Chisel	*	*	*	5	2	1	2	1	2	1	*	*
	Scissors	*	*	*	*	1	*	1	1	*	*	*	*
	Small Hammers	*	*	*	*	*	*	*	*	*	1	*	*
	Wire	*	*	1	2	*	1	*	1	2	*	1	*
Ornaments	Rings	*	*	*	4	4	3	4	*	4	*	1	*
	Bangles	*	*	*	2	*	1	*	1	*	1	*	1

Note: * - indicate absence

In the early samples, the amount of copper was high. In Devnimori samples, later in time, copper is almost absent. Pitting and corrosion remained a common feature in many of the samples. The chemical and metallographic studies indicated that the extraction of wrought iron was known to the smiths of this region during 400 B.C. Due to heavy corrosion only a few specimens from Nagara revealed only relic carbide (Fig. 10) and pseudomorphs of carbide embedded within the corrosion products. The microstructure of specimens from Phase I samples from Nagara I and Timberva I revealed a high amount of slag in them indicating direct smelting /bloomery process (Agrawal 2000). To some extent the slag inclusions were removed by forging in red-hot condition.

Early specimens of Timberva and Nagara show uniform slag distribution in the microstructure. The uniform distribution of slag inclusion is the characteristic feature of wrought iron (Fig. 11). The iron at this stage might have been produced by direct heat treatment followed by forging. The abundance of slag remains

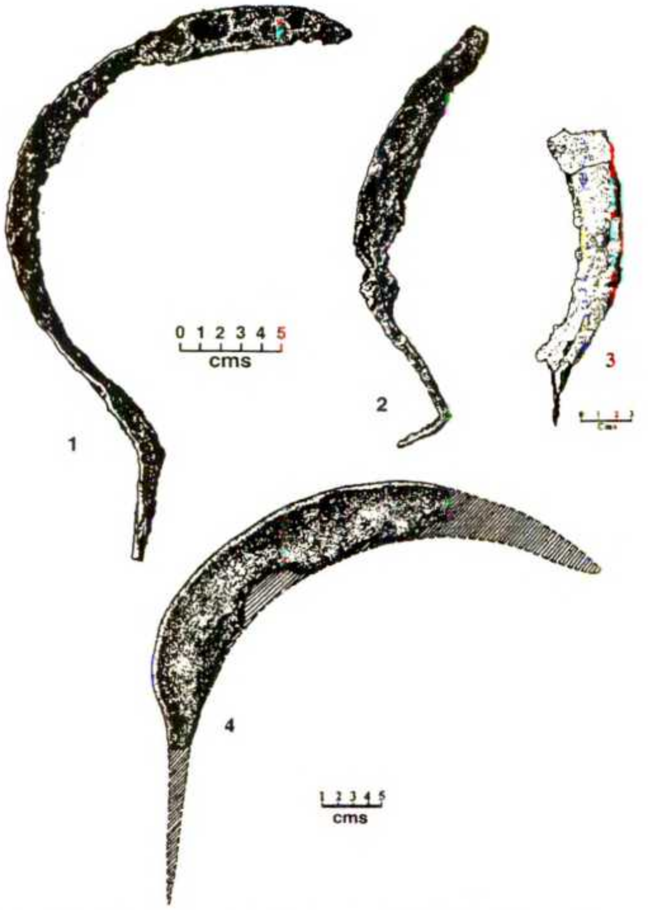


Fig. 8: Sickles: 1-Devnimori, 2-Shamalaji, 3-Nagara, 4-Dwarka

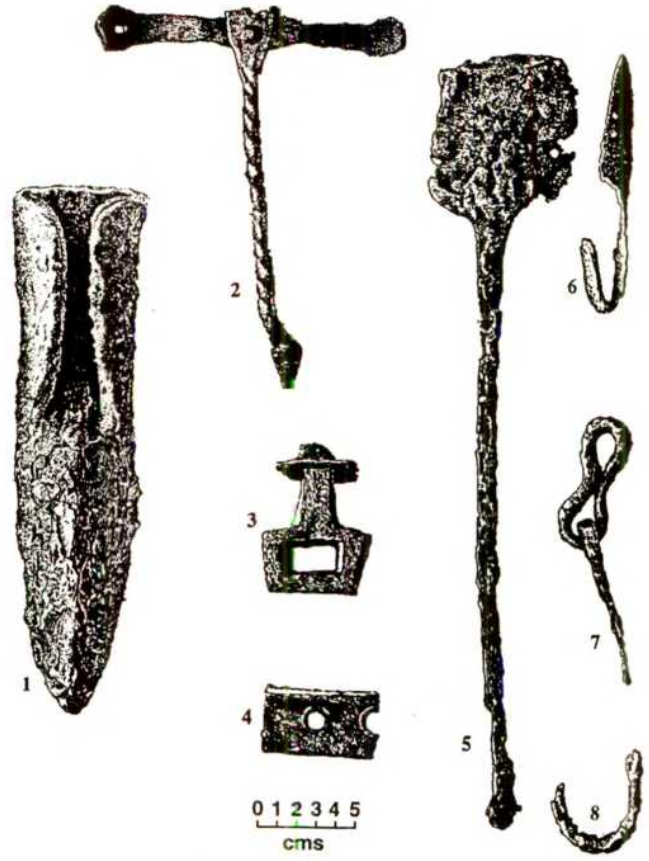


Fig. 9: Miscellaneous objects: 1-Ploughshare (Dhatva), 2-drill, 3-Livet, 4-iron sheet (Shamalaji), 5-Trowel, 6-scissor, 7-hinge, 8-hook (Devnimori)

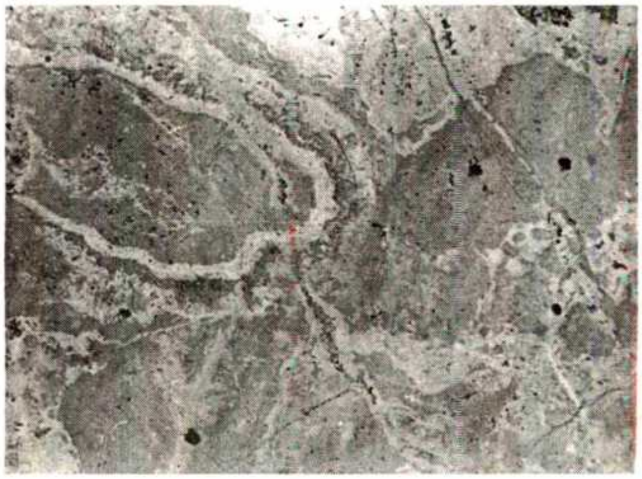


Fig. 10: Photomicrograph showing relic carbide structure (100x)

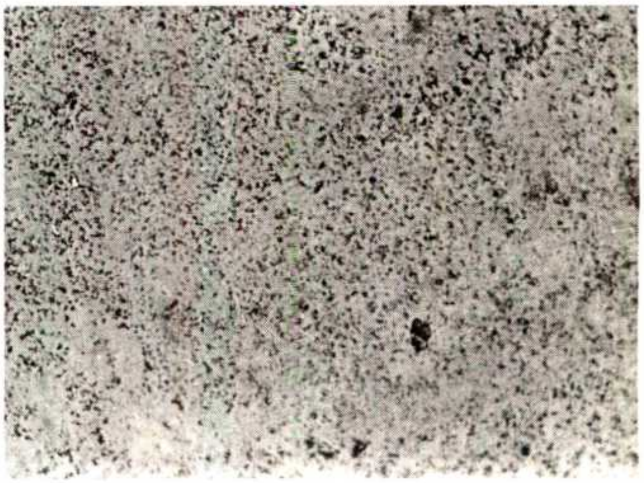


Fig. 11: Photomicrograph showing uniform slag inclusion in the matrix (100x)

Table 4: The chemical composition of representative samples

Sp.No.	Site	Period	Fe	C	S	P	Cu	Ca	Mg	Mn	Si	Ti	Al	Ni
1	Nagara	I	60.02	0.04	0.08	0.014	0.03	.0.28	0.01	0.01	1.9	Ab	0.18	Ab
2	Nagara	II	62.02	0.08	0.12	0.04	0.02	0.47	0.17	0.01	2.02	Ab	0.12	Ab
3	"	"	64.12	0.12	0.08	0.04	0.02	0.41	0.17	0.01	2.02	"	0.02	"
4	"	"	63.97	0.22	0.07	0.12	0.04	0.2	0.05	0.01	2.01	"	Tr	Tr
5	"	"	64.12	0.19	0.07	0.12	0.04	0.02	0.15	0.01	2.1	"	Tr	0.04
6	"	III	67.57	0.32	0.09	0.05	0.02	0.21	0.08	0.02	3.03	"	0.21	0.02
7	"	"	64.82	0.21	0.11	0.15	0.01	0.61	0.05	0.03	1.81	"	0.31	0.04
8	"	"	61.85	0.32	0.01	0.03	0.03	0.59	0.31	0.22	1.89	"	0.21	Tr
9	"	"	63.32	0.31	0.06	0.01	0.02	0.61	0.05	0.03	1.88	"	0.12	"
10	"	"	59.32	0.41	0.08	0.04	0.04	0.51	0.07	0.01	1.99	"	Tr	Tr
11	"	"	63.97	0.61	0.08	0.04	0.02	0.23	0.11	0.06	2.11	"	Tr	0.05
12	"	"	60.92	0.52	0.06	0.15	0.02	0.32	0.12	0.03	1.96	"	Tr	Tr
13	"	"	60.82	0.44	0.07	0.04	0.02	0.41	0.03	0.04	1.88	"	0.62	0.01
14	"	"	64.44	0.33	0.05	0.06	0.09	0.21	0.11	0.02	2.01	"	0.61	0.01
15	Timberva	I	58.55	0.08	0.07	0.05	0.04	0.41	0.22	0.05	1.97	"	0.41	Tr
16	"	"	60.11	0.11	0.06	0.05	0.32	0.48	0.05	0.03	1.88	"	0.44	Tr
17	Shamalaji	I	62.68	0.29	0.06	0.08	0.03	0.34	0.12	.0.01	1.1	"	0.19	0.04
18	"	"	63.01	0.66	0.08	0.07	0.02	0.11	0.12	0.1	1.2	"	0.04	Tr
19	"	"	65.11	0.73	0.04	0.05	0.01	0.11	0.12	0.1	1.21	"	0.03	Tr
20	"	"	66.55	0.7	0.03	0.08	0.2	0.14	0.21	0.12	1.1	"	0.21	Ab
21	"	II	67.76	0.67	0..02	0.05	0.03	0.12	0.21	0.13	1.01	"	0.21	Ab
22	"	"	66.54	0.61	0.04	0.03	0.03	0.11	0.21	0.13	1.01	"	0.01	Ab
23	Devnimori	II	98.78	0.21	0.04	0.02	Ab	0.11	0.21	0.12	1.01	"	0.01	Ab
24	"	"	98.11	0.21	0.06	0.02	Ab	0.12	0.06	Tr	Ab	"	0.02	Ab
25	"		98.88	0.16	0.05	0.01	Ab	0.11	0.04	Tr	Ab	"	0.03	Ab
26	"	"	99.01	0.17	0	0.02	Ab	0.09	0.04	Tr	"	"	0,02	"

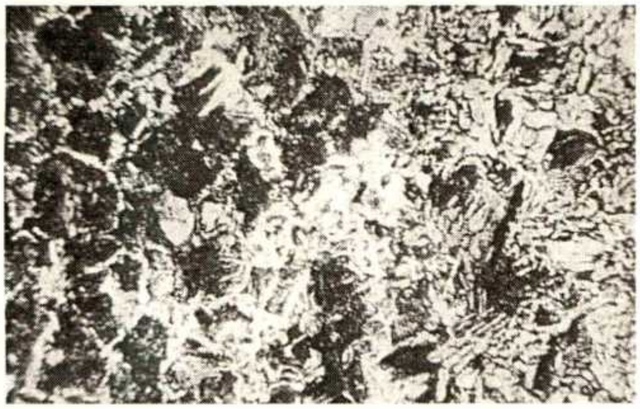


Fig. 12: Photomicrograph showing preferential carburisation (100x)

indicates that they were unable to completely remove the slag. The aforesaid inferences indicate that metal technology in the Phase I of the Early Historic period was in its incipient and experimental stage.

A few objects from Nagara made of wrought iron revealed preferential carburisation (Fig. 12). These objects were case hardened to enhance their properties. They highlight introduction of carbon involved in deliberate steeling. The blacksmiths would have had no reason to make such innovations unless they understood the properties, which such process can impart to the object.

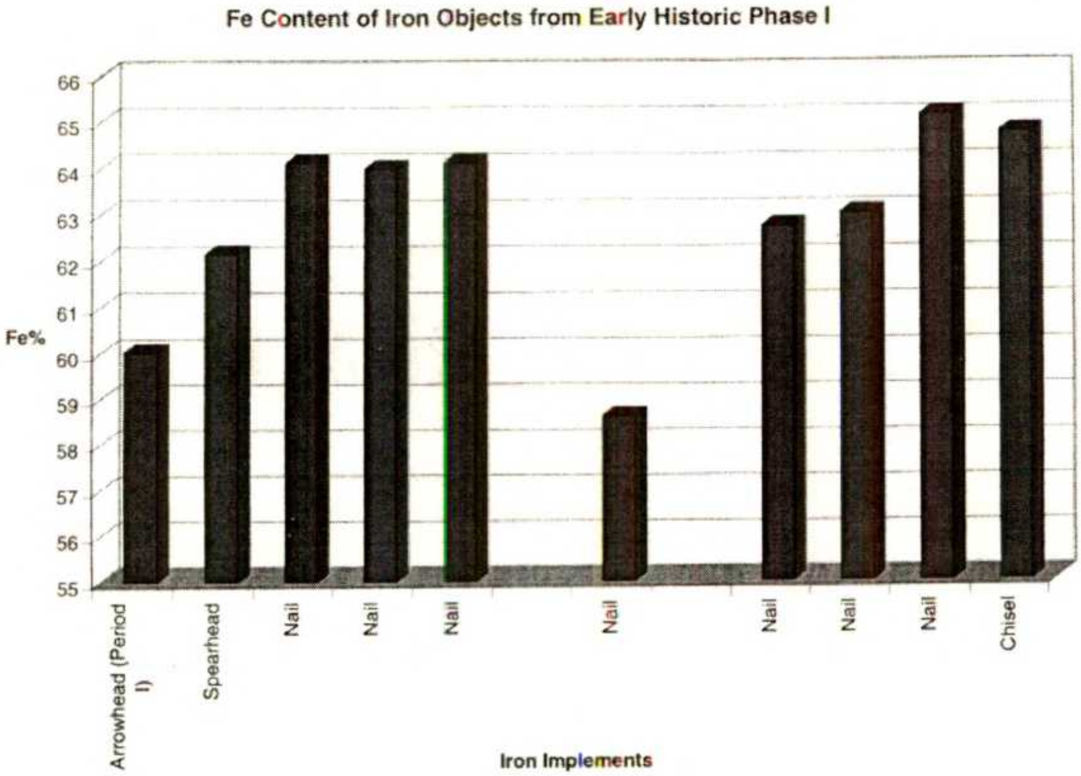


Fig. 13: The iron content of objects in Phase I

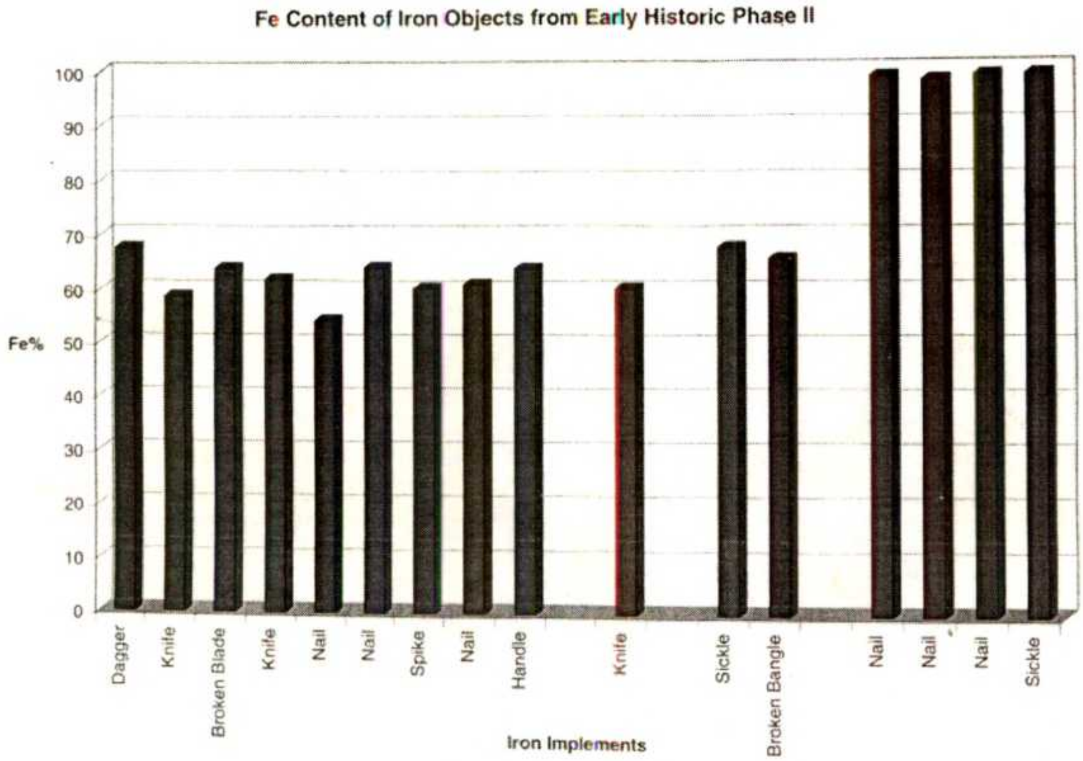


Fig. 14: The iron content of objects in Phase II

Further, the iron content in the samples from Phase I (Fig. 13) to Phase II (Devnimori ones) (Fig. 14) shows a clear-cut increase from 55 to 98%. The high percentage of iron and reduced impurity in Devnimori samples indicates the prevalence of efficient metal extraction processes. The smiths were capable of eliminating impurities effectively from passing into the object while smelting as well as during fabrication.

The microstructure revealed preferential carburisation in many of the objects. This might have been applied to the objects to impart more strength and a durable working edge. This actually indicates that they were aware of the properties that can add strength to an object through carburisation (Fig. 12).

The Phase II samples from all the sites show innovation. The late specimens show the decrease in slag content in their microstructures. All the above factors indicate that by this stage the Early Historic community was able to completely remove all impurities and slag from the bloom (Patel 1999).

The percentage of carbon increases as indicated by the chemical composition. The carbon is introduced into iron to convert it into steel. Thus they knew the process of carburisation or case hardening. The mechanical property of the objects was thus increased by carburising it or by case hardening. The microstructure showing the low carbon and high carbon areas in the sections further substantiate the practice of carburisation techniques employed by the smiths.

In Phase II, another innovation is observed in fabrication techniques. Evidence of hardening the surface by quenching and tempering to martensitic features is visible from a few iron specimens from Nagara and Shamalaji. Most of the samples of Nagara III and Shamalaji II showed strips of alternate ferrite and cementite areas, i.e. high and low carbon strips are seen arranged alternately (Patel 2001). Strips of iron were piled one on the other and forge welded together to attain the requisite ductility (of wrought iron) and hardness (of carburised iron). Carburisation of thin sheets of iron in a charcoal fire and subsequent lamination and forge welding of alternate layers of carburised and uncarburised sheets, i.e. lamination technique (Agrawal *et al.* 1990) (Fig. 15) is found to be one of the outstanding achievements of this period. The uniform structure of pearlite and ferrite in Devnimori samples indicate slow cooling after forging (Fig. 16).

The microstructural studies conducted by using samples from contemporary blacksmith products made out of scrap metal and tribal objects revealed some interesting features. The microstructures of the aforesaid two categories of objects showed similarities with the microstructural features of Devnimori samples. The equiaxed ferrite structures (Fig. 17) are common features. The

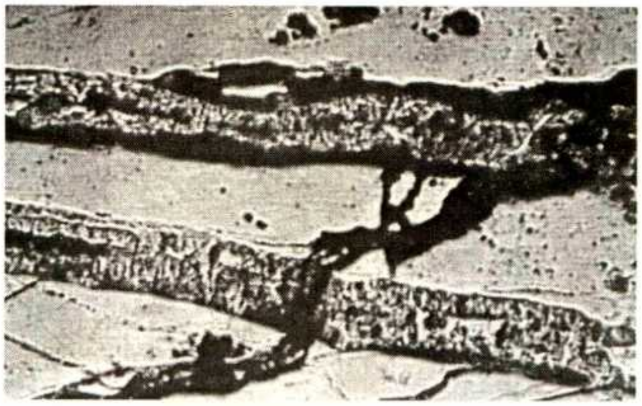


Fig. 15: Photomicrograph showing lamination (100x)

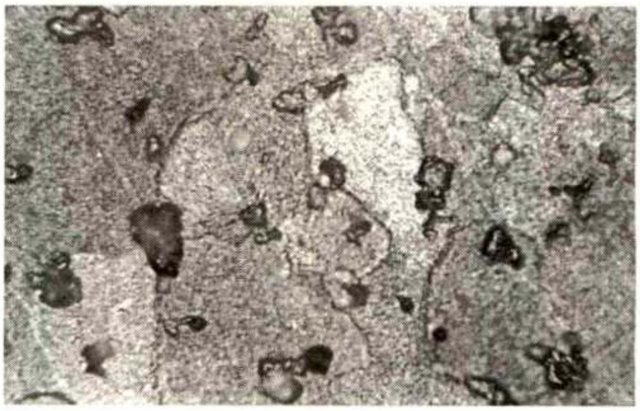


Fig. 16: Photomicrograph showing ferrite and pearlite in the matrix (100x)

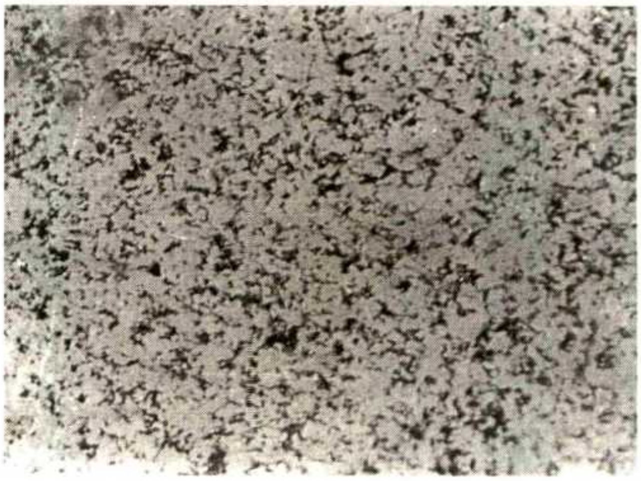


Fig. 17: Photomicrograph showing equiaxed ferrite (100x)

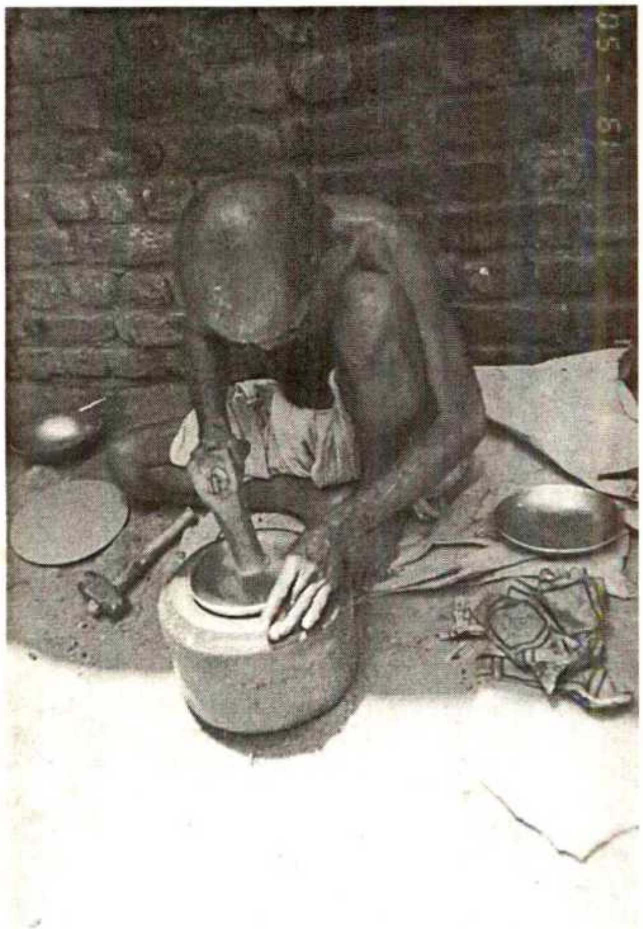


Fig. 18: Contemporary blacksmith applying sinking method

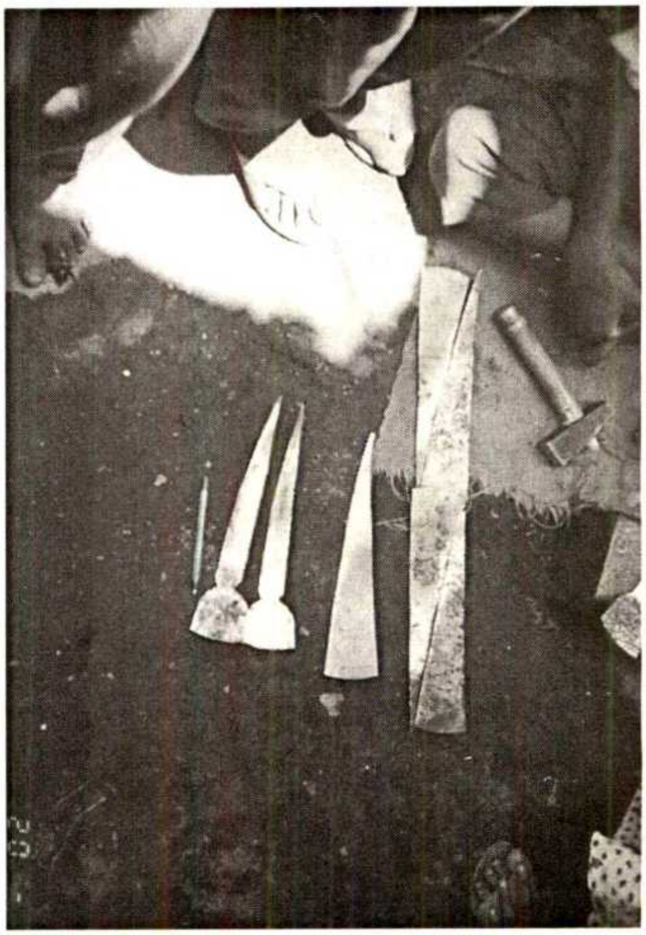


Fig. 19: The thin metal sheet used for making *tavetas*

widmanstatten features, which develop due to quenching, are also observed in contemporary as well as in Devnimori samples. Thus there is an indication of similarity in fabrication technique among the Early Historic ancient and contemporary specimens. This further implies that Devnimori smiths may have practiced processes and fabrication methods similar to that of present-day traditional blacksmiths.

The present-day blacksmiths do not smelt iron. They only exercise melting activities and use the scrap iron brought from the market to produce various objects. They heat the scrap iron to red-hot state in an open hearth and then forge them into strips on an anvil in front of the hearth. Fashioning the objects from metal sheets is done through sinking. Sinking is the shaping of metal by hammering from the interior of an object into a depression in an anvil (Fig. 18). Strips of metal sheets cut by using chisels are forged for shaping respective shapes such as *tavas* and *tavetas* (Fig. 19).

As early as 1973, K.T.M. Hegde proposed continuity of smelting of iron-ore smelters and present-day iron working communities namely, Loharias. Since contemporary Loharias do not smelt iron, nothing can be said about the smelting process (primary production) in the present study. However, the similarities in the microstructure developed due to the fabrication techniques is significant as it validates inferences drawn regarding the Early Historic production technology. An ethno-archaeological survey to document primary production areas/iron working sites, and various indicators for the metallurgical process of the Early Historic period can substantially help to develop a more effective model for extractive metallurgy of this period.

Conclusion

To sum up, the technology of iron during Early Historic period indicated a definite advancement. Typological analysis of these iron objects showed various types, namely hunting tools, agricultural tools, household objects, tools used in building activity, craft activity and ornaments. In the early phase the tool types were less. The beginning of Phase II showed an increase in number as well as variety of tools. The later part of Phase II showed profuse use of iron for diverse craft activities.

The smiths produced variant quality iron ranging from wrought iron to medium steel. The fabrication techniques adopted are of cold working, hot working, carburisation and lamination. Quenching and tempering was also observed. Evidence of hardening the surface by quenching and tempering to martensitic features are visible from few specimens of Nagara and Shamalaji. Since iron could not be melted and cast easily, carburisation of thin sheets of iron in charcoal fire and subsequent lamination by forge welding of alternate layers of carburised and uncarburised sheets is found to be a significant achievement of this period. Hence the most common form of shaping was forging, i.e. 'controlled shaping of metal by the force of a hammer', usually on an anvil/stake. Since forging not only shapes the object, it also hardens the object, forging was an important step in manufacturing edged tools.

The ethnographic survey of documenting the working practices of contemporary and tribal blacksmiths of this region; the comparison of the microstructures of their products with ancient samples enabled us to establish what methods and processes might have been used by the early iron working communities in Gujarat.

References

Agrawal, D.P. 2000. *Ancient Metal technology and Archaeology of South Asia – A Pan Asian Perspective.* New Delhi: Aryan Books International.

Agrawal, O.P., H. Narain and S.K. Bhatia 1990. Lamination Technique in Iron Artefacts in Ancient India, *Historical Metallurgy* 24(1): 12-26.

Ansari, Z.D. and M.S. Mate 1966. *Excavations at Dwaraka.* Pune: Deccan College.

Bharadwaj, H.C. 1979. *Aspects of Ancient Indian Technology.* Delhi: Motilal Banarasidas.

Chakrabarty, D.K. 1976. The Beginning of Iron in India, *Antiquity* 198: 114-124.

Chakrabarty, D.K. 1992. *The Early Use of Iron in India.* Delhi: Oxford University Press.

Clarke, D.L. 1968. *Analytical Archaeology.* London: Methuen and Co.

Garside, E.J. 1957. *Process and Physical Metallurgy.* London: Charles Grittin & Co. Ltd.

Gaur, R.C. 1983. *Excavations at Atranjikhera.* Delhi: Motilal Banarasidas.

Hegde, K.T.M. 1973. A Model for Understanding Ancient Iron Metallurgy, *Man* 8(3): 416-421.

IAR: *Indian Archaeology: A Review.* Annual Publication of the Archaeological Survey of India: New Delhi.

Mehta, R.N. 1955. Excavations at Timberva. Vadodara: M.S. University of Baroda.

Mehta, R.N. and S.N. Chowdhary 1966. *Excavation at Devnimori.* Vadodara: M.S. University of Baroda.

Mehta, R.N. and S.N. Chowdhary 1975. *Excavation at Dhatva.* Vadodara: M.S. University of Baroda.

Mehta, R.N. and A.J Patel 1967. *Excavations at Shamalaji.* Vadodara: M.S. University of Baroda.

Nagaraj Rao, M.S. 1971. *Protohistoric Cultures of Tungabhadra Valley.* Dahrwar:

Patel, A. 1999. *Iron technology in Early Historic India- A Case Study of Gujarat.* Unpublished Ph.D.Thesis. Vadodara: M.S. University of Baroda.

Patel, A. 2001. Technological Studies of Iron Implements from Nagara, *Puratattva* 31: 165-168.

Rao, S.R. 1966. Excavation at Amreli, *Bulettin of the Museum and Picture Gallery* XVIII. Baroda.

Subbarao, B. 1953. Baroda Through The Ages. *Maharaja Sayajirao University Archaeology Series* 1: 84-86.

The Harappan Heritage and the Aryan Problem

Michel Danino

The Mother's Institute of Research
Kotagiri 643 217
India
Email: micheld@sify.com; micheld@hclinfinet.com

Abstract

Because of the Aryan invasion theory, the Harappan civilization was initially assumed to have had no direct relation with later historical India. Yet archaeological evidence has increasingly shown its numerous connections with the subcontinent's later developments in the fields of science and technology, agriculture, town planning, art and craft, religion and culture. The last two are of special importance not only in refuting the unscientific Aryan invasion theory, but also in understanding the overall continuity of Indian civilization. The Harappan heritage is a cultural continuum and not a cultural hiatus.

Five Angles to the Issue

In the Indian context, the Aryan problem refuses to die down. Whether at the level of scholars, academics, the media or textbooks, we keep bumping into it at every turn — naturally so, since nothing less than the origin of Indian civilization is at stake. Unfortunately, much of the debate remains poorly informed, ploughing ever and ever again the divisive furrows cut by nineteenth-century racial interpretations of the Veda, or by Sir Mortimer Wheeler's flamboyant misinterpretations, and ignoring in the process advances of recent decades in many fields.

The issue has many angles, but principally it can be viewed and tested from archaeological, the anthropological, the linguistic, the literary and the cultural perspectives. The so-called Aryan Invasion theory (AIT, now often demoted to an "Aryan migration theory") has emphatically failed on the first three fronts, remains ambiguous on the fourth, and has been meeting with a growing challenge on the fifth. This last, cultural angle is the focus of this paper, but let us first briefly recall some conclusions reached as regards the first four.

(i) The archaeological record has completely failed to identify artefacts that could be associated with incoming people around the supposed time of the invasion. That the Aryan conquerors should have left no physical trace, direct or indirect, of their arrival in the Subcontinent is hard to believe and has made most archaeologists reject AIT (Kenoyer 1998: 174; Shaffer 1984: 88; Jarrige 1995: 21; Lal 1997: 283.).

(ii) The skeletal record, from the northwest to the Ganga region, shows no sign of any "demographic disruption" centuries before or after 1500 B.C. Kennedy (1982: 291), for example, refers to a "... biological continuum [... with] the modern populations of Punjab and Sind," thus endorsing earlier skeletal studies by a number of Indian experts, who had found little difference between Harappan skeletons and present-day populations in those regions as well as in Gujarat (Gupta 1996: 154-157). In other words, the supposed Aryans, initially described as racially quite distinct from the earlier populations of the Subcontinent, have also left no biological trace of their invasion.

(iii) Disregarding this baffling absence of physical evidence, most Western linguists cling to AIT as they find in it a convenient explanation for the Indo-European linguistic connection, even as archaeologists and anthropologists have long discarded diffusionist models. Linguists do not seem to mind that after almost two centuries of linguistic studies, the quest for the supposed "original homeland" of the Proto-Indo-Europeans remains as elusive as ever, with at least a dozen locations from Central Europe to the Russian steppes, the Black or Caspian seas or Bactria still being proposed (Bryant 2002: 140). Finally, alternative theories explaining the linguistic connection outside the AIT framework (Elst 1999; Bryant 2002) have not received the attention they deserve.

(iv) India's oldest texts are absolutely silent on any homeland located outside the subcontinent. Rather, river names make it clear that the Rigvedic geography is that of India's northwest. Indeed, the importance of the Saraswati

LAP 2290

934 M 34

both in the Rigveda and as the chief epicentre of the Harappan civilization provides a strong bridge between the two. Moreover, Indian as well as Western students of the Vedic texts (Sri Aurobindo 1971; Erdosy 1994: 232; Trautmann 1997) have convincingly shown how earlier racial interpretations of the Rigveda were based on nothing more than misreading of the Vedic hymns — however stubbornly our Indian textbooks may choose to repeat those misinterpretations.

Despite such setbacks, many proponents of AIT still go by the old view that Vedic culture entered India with the Aryans, and that this culture was "... diametrically opposed to its [Harappan] predecessor" (Basham 1981: 29). Some scholars go further and assert that the Harappan civilization "is not the direct origin of Indian civilization" (Sergent 1997: 105). In other words, we should expect a total, or at least considerable, cultural hiatus between the Harappan world and the second phase of urbanization emerging from the Ganga plain.

Yet archaeological evidence conjures up a cultural continuum rather than a hiatus, as we will see from the following brief overview. The issue has of course been intensely debated ever since the discovery of the Indus-Saraswati civilization, but recent studies (Kenoyer 1998; Lal 2002) have increasingly stressed the continuity of Indian civilization from Harappan times in every aspect of life. We will highlight here a few clear instances of such continuity, as well as elements of Vedic culture found in the Harappan world.

Town Planning and Building

Although the impressive Harappan town planning disintegrated with the collapse of the urban phase (c. 1900-1800 B.C.), some of its traits and techniques survived in the smaller rural settlements and reappeared in the early historic period more than a thousand years later. For instance, most Harappan cities, like early historical ones, were oriented along the cardinal directions, followed grid plans, were of large size, used enclosing walls, etc. (Coningham 1995).

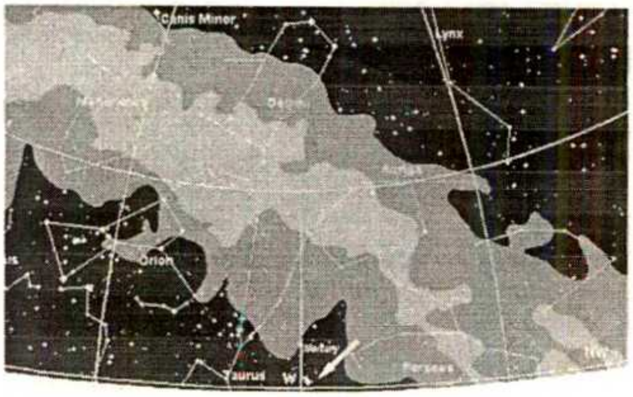


Fig. 1: Pleiades (Marked by white arrow) setting due west at Mohenjo-daro on 22 March 2700 B.C. (sky prepared with Redshift software)

Highly significant is Wanzke's observation (1987) that the alignment of Mohenjo-daro's citadel has a 1° to 2° clockwise divergence from the cardinal directions and in fact points to an east-west alignment along the Pleiades star cluster (*Krittika*), which rose due east and set due west (Fig. 1) during the mature Harappan phase at the vernal equinox (because of the precession of the equinoxes, it no longer does). This brings to light an important Vedic connection, since in the earliest astronomical texts, *Krittika* is the first of the 27 Nakshatras. Michael Jansen made similar observations (Kenoyer 1998: 52-53). As Parpola (2000: 201) notes, "Many things point to a Harappan origin of the nakshatra calendar." Moreover, the *Satapatha Brahmana* (2.1.2.3) refers to a time when the Pleiades "does not swerve from the east," which is precisely the mature Harappan period. Although this connection between Harappan town planning and Vedic astronomy is endorsed by astrophysicist Malville and Gujral (2000: 4), it would be interesting to see whether more systematic astronomical studies of Harappan cities might confirm it. Dholavira (in Kachch), for instance, appears to be a good candidate.

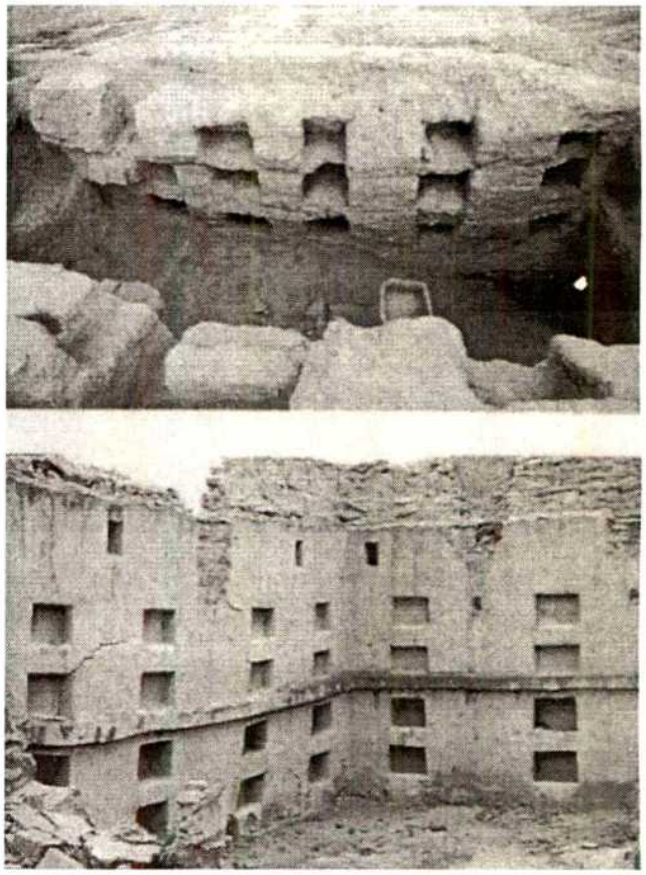


Fig. 2: Pattern of niches at Pirak. Above: end of the second millennium B.C.; Below: recently abandoned Hindu quarters

Another Harappan urban trait is the threefold division of the cities. At Dholavira, the excavator, Bisht (1997: 111-112) finds three distinct areas "designated tentatively as 'citadel', 'middle town' and 'lower town' which temptingly sound analogous to three interesting terms in the Rigveda, viz., '*parama*', '*madhyama*' and '*avama*'..." Bisht (1999) also collected many terms and passages from the Rigveda and set them against Harappan town planning, fortifications, types of houses, etc. Such observations certainly clash with the old view that there is no parallel between the Rigveda and the Harappan town planning (Thapar 2000: 15).

Coming to specific building techniques, it is well-known that the typical Harappan layout of an average house, with a central courtyard, rooms on three sides and a wide entrance gate on the fourth, is found even today in many rural regions of North India, no doubt thanks to its simplicity, economy and great convenience. Even techniques of wall building and floor laying have been preserved to the last detail: for instance the mixing of terracotta nodules and charcoal around Kalibangan, unchanged over 4500 years (Lal 2002: 95). In a striking case, Pirak's excavator, Jarrige (1995: 24), noticed that a symmetrical pattern of four levels of niches carved in walls (end of the 2nd millennium B.C.) was still used in nearby Hindu quarters abandoned a few years before the excavation (Fig. 1).

Governance

There is widespread agreement that the Indus-Saraswati civilization had an efficient yet low-profile administration. Cities were well-maintained, civic discipline seems to have been the norm, and the lack of evidence of warfare or man-made destruction points to a generally peace-loving or non-aggressive culture. To keep together such a wide area so smoothly for so long is no small achievement. As Agrawal (1993: 452) put it, "In a third millennium context, when communication and transport must have been difficult, the credit for unifying the north and west of the subcontinent goes to the Harappans. They were the first to achieve this unification of a society with so much diversity."

Yet in stark contrast with contemporary civilizations such as those of Egypt or Mesopotamia, we find no palaces or other monuments that could be clearly associated with a ruling class. No glorification or even portrayal of the rulers is known. The initial assumption of a centralized Harappan empire does not fit well in such a picture, and opinion has been veering towards a model of "city-states" (Kenoyer 1997). Possible regional capitals (Fig. 3) include Mohenjo-daro, Harappa, Ganweriwala and Lothal. Lal (1997: 236) in addition brings a parallel with the Sixteen States or *Mahajanapadas* of later period. The case for a rebirth of Harappan governance in the form of the Early Historic "republics" does seem valid, although we will need more evidence to firm it up.

Science and Technology

The Indus-Saraswati civilization required a fair role of science to build cities, ship goods to Mesopotamia, manufacture seals or harden bronze. Harappans certainly loved both mathematics and standardization; for instance, the common brick sizes followed a ratio of 1:2:4 (e.g. 7 x 14 x 28 cm), which is often found in proportions of rooms, houses, some public buildings, and even, as Michael Jansen pointed out (Kenoyer 1998: 57), in entire sectors of Mohenjo-daro's walled "citadel."

Curiously, much of this science and technology survived the urban collapse, and resurfaced in the cities of Ganga plain a thousand years later. Such is the case of the standardized system of stone weights (Fig. 4), unique in the ancient world (Misra 2001; Mainkar 1984: 145). Similarly, the *Arthashastra*'s *angula* unit of 17.78 mm is almost exactly ten times the unit on the Lothal scale, 1.703 mm (Mainkar 1984: 147).

Then we must note the partial use of a decimal system by Harappan engineers: returning to the series of weights, at first it goes (taking the first weight, roughly 0.86 g, as a unit): 1, 2, 4, 8, 16, 32, 64; then, rather than pursue this geometric progression, it switches to multiples of 10, 100 and 1,000: thus we have 160, 200, 320, 640, 1,600, 3,200, 6,400, 8,000 and 12,800. Let us recall that the Rigveda, organized in ten Mandalas, constantly uses numbers 10, 100, 1000, etc. A revealing hymn (II.18.4-6) describes Indra's chariot as "ten-sided" and mentions its number of horses in the following sequence: 2, 4, 6, 8, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. One needs to go deeper into the Harappan as well as Vedic origins of the decimal system in India, which eventually gave rise to the remarkable decimal place-value system of numeral notation.

Harappan technologies bring to light numerous instances of continuity. Bronze casting, as used for the famous "dancing girl" statuette (Fig. 5), followed the technique of *cire perdue* (lost wax) which was later widespread in the Subcontinent — all the way to the Sthapathys of Swamimalai (near Kumbakonam in Tamil Nadu), who use exactly the same technique today. As Kenoyer (1998), Rao (1991: 182-183) and others have documented, whether we look at bead and bangle making, gold working, shell and ivory carving, traditional techniques in contemporary India have changed little since Harappan times. Faience craft included blue-glazed ceramics produced with the same copper oxide pigments used today; sophisticated techniques for drilling long beads, for colouring and bleaching, were distinctly Harappan and are still in use. Even *kamandalus* have not changed their shape for nearly 5000 years. Indeed, archaeologists have often turned to

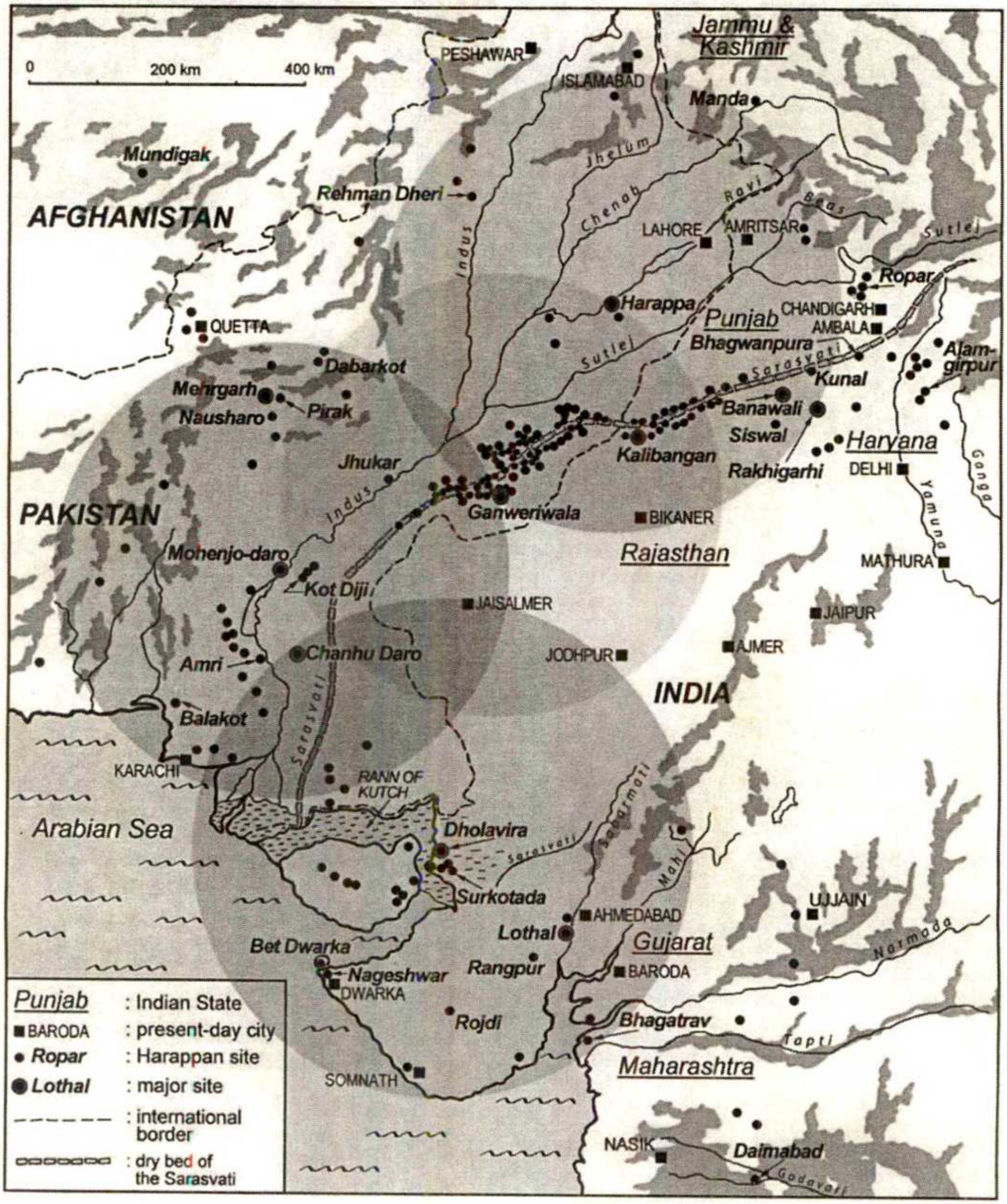


Fig. 3: Map of the Indus-Saraswati civilization showing possible city-states (author's map)

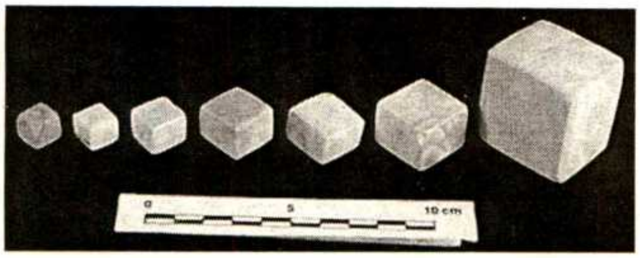


Fig. 4: Part of the Harappan weight system (from Allahdino)

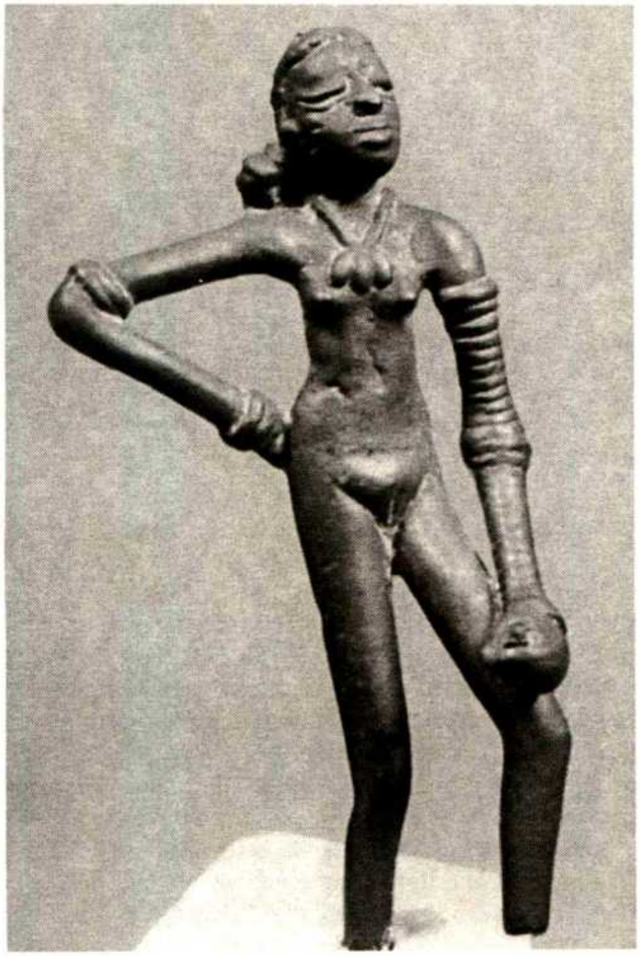


Fig. 5: The 'dancing girl' cast in bronze with the lost wax technique

local craftsmen to understand such Harappan techniques; Kenoyer (1998: 151-152) for example got local potters to re-create Harappan pottery using the same techniques.

Agriculture and Shipping

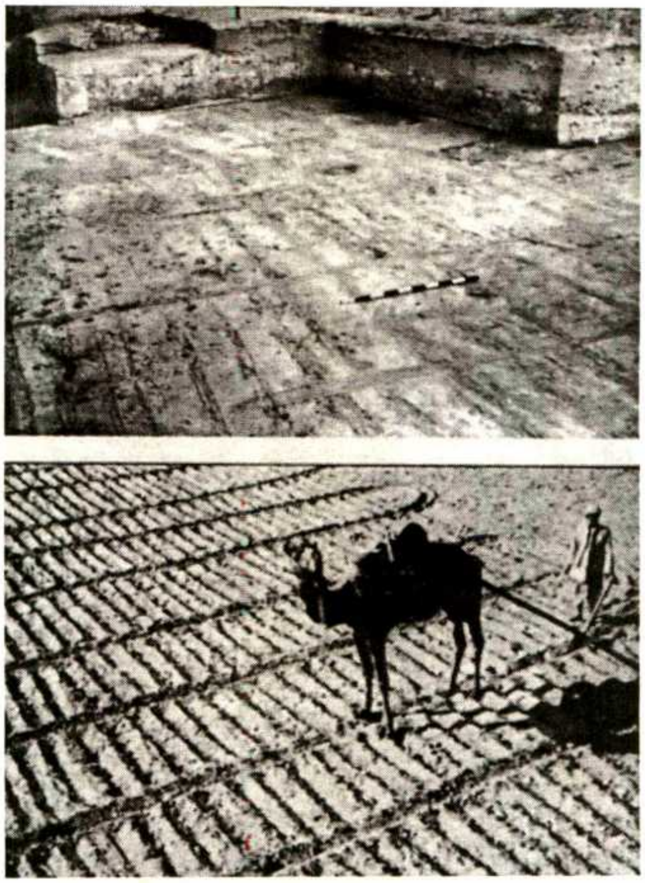


Fig. 6: Kalibangan. Above: Early Harappan ploughed field; Below: modern field ploughed on the same pattern

Harappan agriculture relied on ox-carts, ploughshares and (at least in some areas) irrigation, as in India today. A terracotta model of a ploughshare found at Banawali has a shape that would be quite familiar to today's peasant. Then we have the case of the ploughed field at Kalibangan (Lal 1998: 57-62), which refines intercropping with a double network of perpendicular furrows, in which north-south furrows (with shorter shadows) receive taller crops while shorter ones grow in east-west furrows — a system still practised in the same area at least till recently (Fig. 6).

As regards shipping, Indus seal and a tablet (Fig. 7) depict a boat with high ends and a central cabin, the like of which can still be seen on the same river today as a traditional Sindhi houseboat (Kenoyer 1998: 90).

Art and Crafts

We must admit that Harappan art is disappointingly scanty and restrained. The artistic capacity is not in doubt, as the exquisite seals and a few statuettes show, not to speak of

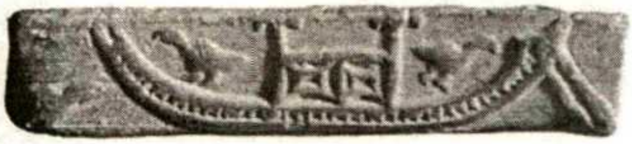


Fig. 7: Terracotta tablet (Mohenjo-daro) depicting a boat

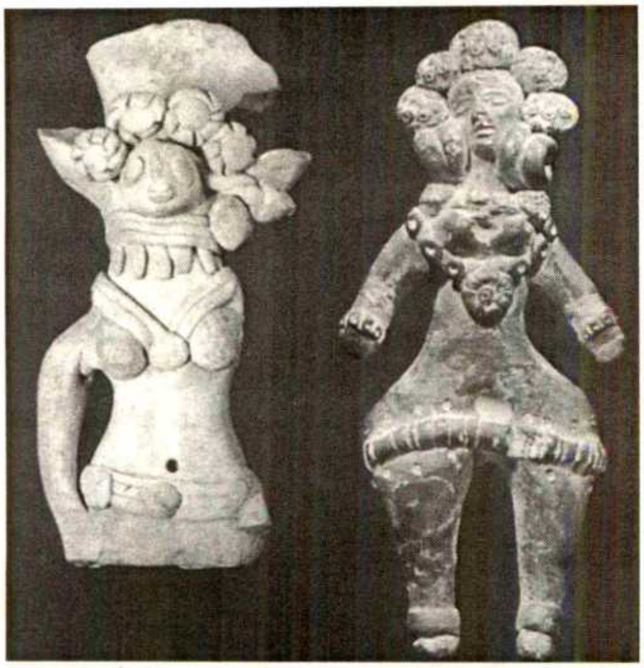


Fig. 8: Two terracotta mother goddesses. Left: from Harappa (c. 2600 B.C.); Right: Mathura style (c. 200 B.C.)

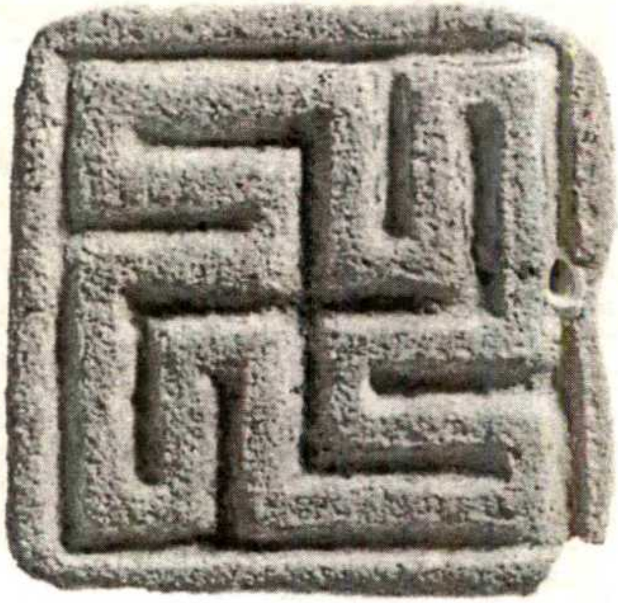


Fig. 9: One of the many svastika seals

elaborate jewellery, a major source of wealth to the Indus-Saraswati civilization. Also the possibility of art forms on perishable material (wood, cloth, etc.) cannot be ruled out. Still, on the whole, we are left thirsting for more artistic expression.

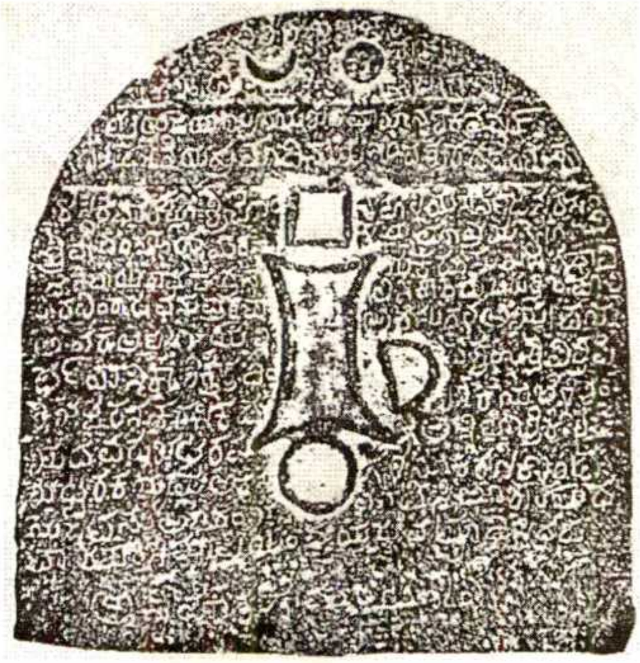


Fig. 10: An inscription (Sonda, A.D. 1674) showing a sacrificial altar identical with the Harappan motif of a square with incurved sides

Yet it is noteworthy that most of these few forms did survive. If we look at some of the Harappan mother goddesses (Fig. 8), we see their unmistakable reappearance in Mauryan art: the same extravagant huge flowers circling the face, similar double necklace and the belt. Among motifs and symbols, the svastika (Fig. 9), depicted on numerous Indus seals, requires no elaboration. Saraswati Amma (1999: 5) brings up an intriguing parallel between the Harappan square with incurved sides (a common design appearing at the centre of the "intersecting circles") and the identical shape of a Vedic sacrificial altar forming part of the *Mahavedi* (Fig. 10; Sarkar and Pande 1999: 76-77). The Harappan "endless knot" is found all over India (in *rangoli* designs for example) and also in inscriptions (Fig. 11; Sarkar and Pande 1999: 128). Similarly symbols

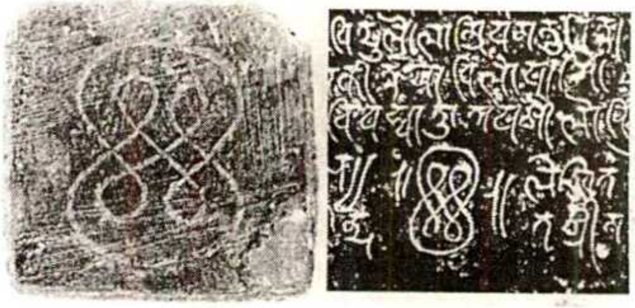


Fig. 11: Two 'endless knots'. Left: copper tablet from Mohenjo-daro; Right: part of a copper plate of Gujarat Rashtrakuta branch (A.D. 883)

like the svastika, the sun, the *chakra*, the cross, etc. are found both in Harappan symbolism and later Indian iconography. Even the mysterious ritual stand, placed in front of the equally mysterious unicorn, appears on coins of the Sangam Age in front of a horse (Krishnamurthy 1997). Motifs commonly used on pottery such as the peacocks, fish, etc. also lived on. The Harappans revered trees, as shown by numerous depictions of trees growing from a low platform, a frequent symbol on coins from Mauryan times onward. The *pipal* was certainly one of their most sacred trees, judging from its frequent depiction on seals and pottery, often in association with deities, and we need hardly stress the exalted status of the *ashvattha* from Vedic times to this day.

Ornaments too have survived such as the numerous types of bangles (even the special way the "dancing girl" wears them, covering the upper left arm, is still in vogue in rural parts of Gujarat and Rajasthan), the semiprecious stone beads, flattened gold beads, and decorated elephant heads.

As for games, the Harappans seem to have been quite fond of them. They had various kinds of board games, and in Lothal, a famous set of terracotta figures does evoke chess — or let us say more cautiously, a possible ancestor of chess. As we know, such board games resurfaced in Mauryan times. Sets of dice (terracotta or stone) were found at Harappa (Fig. 12) and Mohenjo-daro, and seem indistinguishable from today's dice (the only difference lies in the arrangement of the numbers on the cube's faces). Terracotta spinning tops have also been found. Even simple clay discs are still used by children around Harappa, probably for the same games their ancestors played (Kenoyer 1998: 132).

Culture and Religion

After this glance at the more external aspects of Harappan life, let us move on to the more debated fields of culture and religion (the two being of course inseparable). But let us first stress an often forgotten point: in the Harappan context, in the absence of an organized military power, culture acted as a cement helping to hold this vast region together. Also culture could not have played this important role without certain unique strengths. What follows is by no means a complete description of Harappan culture, of which we still know little (let us remember that fewer than 2% of the identified sites have been excavated), but is an attempt to show its inherent "Indianness" (Allchin and Allchin 1997: 188).

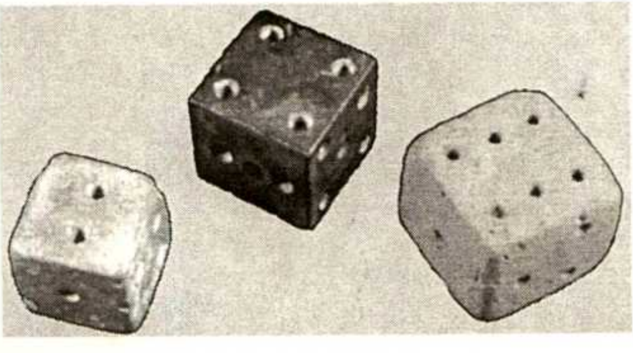


Fig. 12: Clay and stone dice from Harappa

Harappan burial practices generally exhibit respect for the dead, for instance through interment with a few pots and some personal ornaments (bangles in the case of women, various beads, metal mirrors, etc.). The presence of pots, which probably contained food, points to a belief in afterlife, but we find no great display of wealth in the graves: precious metals and stones remained with the living. In other words, death and afterlife were not glorified (as they were in Egypt, at least for the ruling class), and the Harappans seem to have concentrated more on life — a rather typically Indian attitude.

An important element in daily life was water. Individual bathrooms (Fig. 13), numerous wells (700 in Mohenjo-daro alone), the unique drainage system, massive reservoirs (which occupied one-third of Dholavira's area), went well beyond the actual needs of the population. Water was clearly important to the Harappans, but not just for drinking or cooking. Mohenjo-daro's famous "Great Bath" very likely had a ritualistic purpose, and scholars have often suggested that it was part of a temple, an assumption strengthened by the nearby pillar bases. The meticulous care with which sewage water was drained out of the city is also indicative of a preoccupation with cleanliness

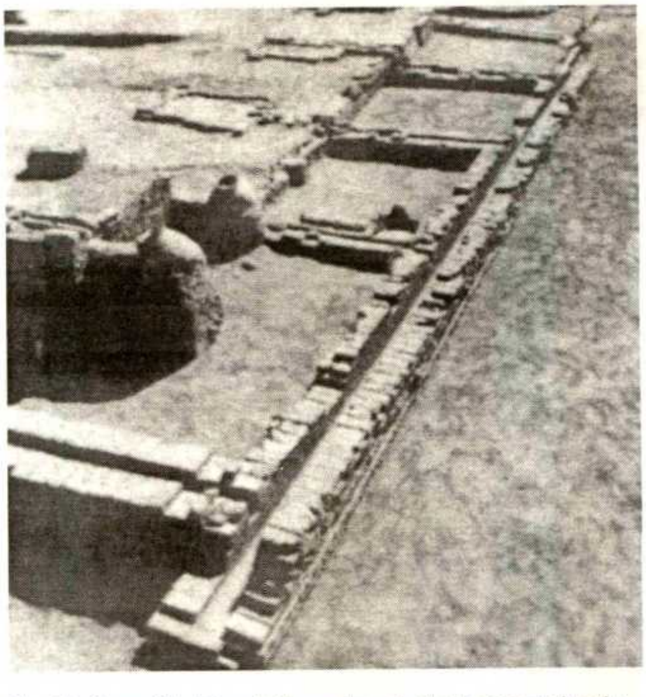


Fig. 13: Row of bathing platforms from Lothal, connected to the common drain

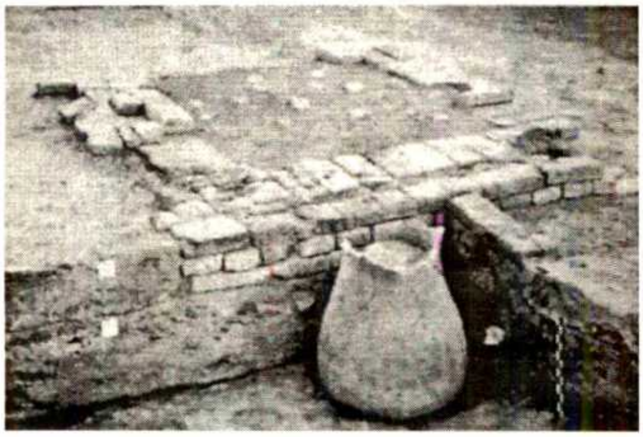


Fig. 14: Fire altar at Lothal

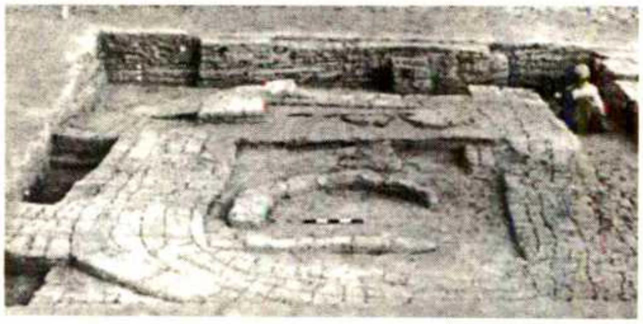


Fig. 15: Apsidal structure at Banawali

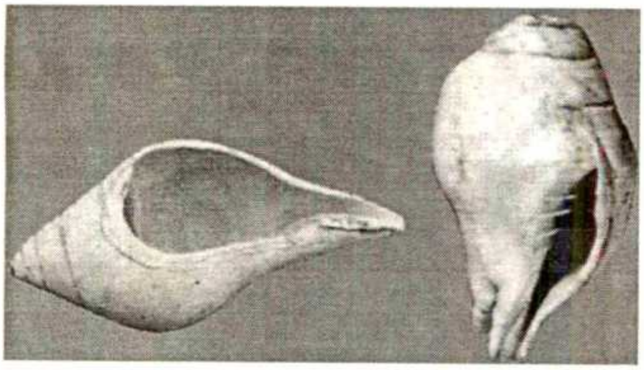


Fig. 16: Conch shells. Left: used for libations (from Mohenjo-daro); Right: used as a trumpet (from Harappa)

almost absent in then contemporary civilizations elsewhere. All this has led archaeologists to "assume that bathing and the purity of water may have had specific ritual significance in the Indus cities" (Kenoyer 1998: 120). We need hardly stress the importance of water for purification in all religions born in the Subcontinent.

The same may be said of fire, and fire altars. These have been found at Lothal (Fig. 14), Kalibangan (in a row of eight, all facing east) and Banawali (Fig. 15), where an apsidal structure evokes one of the common shapes of Vedic altars. If fire worship is confirmed through further evidence, it will establish a strong link with the Vedic practices.

Then we find a number of ritualistic elements that any Hindu of today would feel quite at home with: oil lamps (for instance, the cups on each side of some of the so-called mother goddesses), a *trishul* on at least one seal, a few (though rare) *lingams* (Lal 2002: 118), the conch shell used (Fig. 16) both for pouring libations (one such from Mohenjo-daro is decorated with vermilion-filled incised lines) and for trumpeting (those have their tips sawn off for the purpose) (Kenoyer 1998: 119). At Nausharo (near Mehrgarh), a few female figurines dated 2800-2600 B.C. show traces of red pigment at the parting of the hair (Kenoyer 1998: 44-45), exactly as Indian married women today apply *sindoor*. The famous "priest king" (who may have been neither priest nor king) wears two sacred marks: an "eye bead" at the same spot of today's *bindi*, and another bead on the upper part of the arm (Fig. 17), where Hindus often tie amulets or apply ashes. Though there are few actual depictions of rituals, one tablet represents what is clearly a religious procession (Kenoyer 1998: 83), complete with standard bearers.

Several heavily decorated female statuettes strongly suggest the cult of a mother goddess, in line with the Indian type of worship. As for the so-called Pasupati, there is little agreement as yet on his real identity, and claims

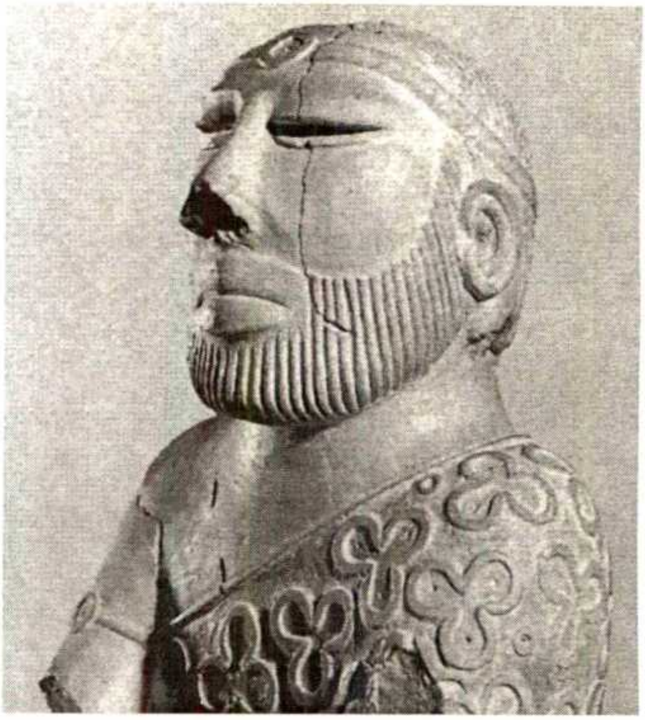


Fig. 17: The so-called 'priest king' in deep contemplation

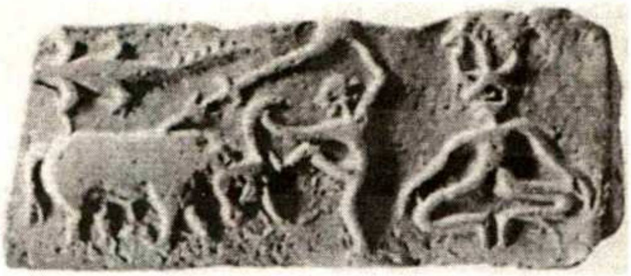


Fig. 18: Slaying of a buffalo (tablet from Harappa)

vary from a proto-Shiva to the first Tirthankar. His imposing presence is undeniable, however, depicted seated in a yogic posture or standing between two branches of *pipal*. In one of the former scenes, he watches another figure slaughtering a buffalo (Fig. 18), a theme reminiscent of later Mahishamardini.

As regards the striking animal symbolism used on thousands of seals, it is quite consistent with a broadly Vedic framework. The hundreds of unicorn seals remind us of *eka sringa*, a description of Vishnu's Varaha avatar, also used by Krishna for himself in the Mahabharata (Shanti Parva 330.27). The ritual stand placed in front of the mythical animal has been taken by some to be a soma filter, by others some portable fire altar. The next most common animal, the bull (Fig. 19) is a Vedic symbol of power and an exalted name given in turn to Indra, Agni or Surya. The elephant, gaur and buffalo figure in the Rigveda, and the remarkable three-headed animal might well represent Agni too (Rigveda I. 146.1). Even the key Vedic theme of the marriage of Heaven and Earth is clearly depicted on a seal from Chanhuo-daro (Mackay 1943: pl. 51: 13; see Parpola 2000: 256), in which a bull mates with a woman from whose head a plant emerges.

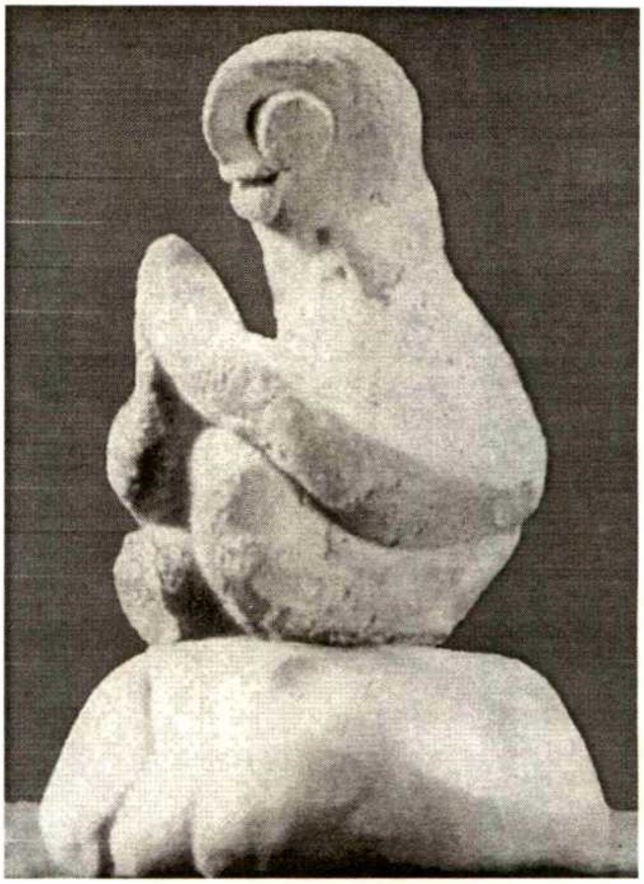


Fig. 20: A cross-legged terracotta figure with folded hands (from Harappa)

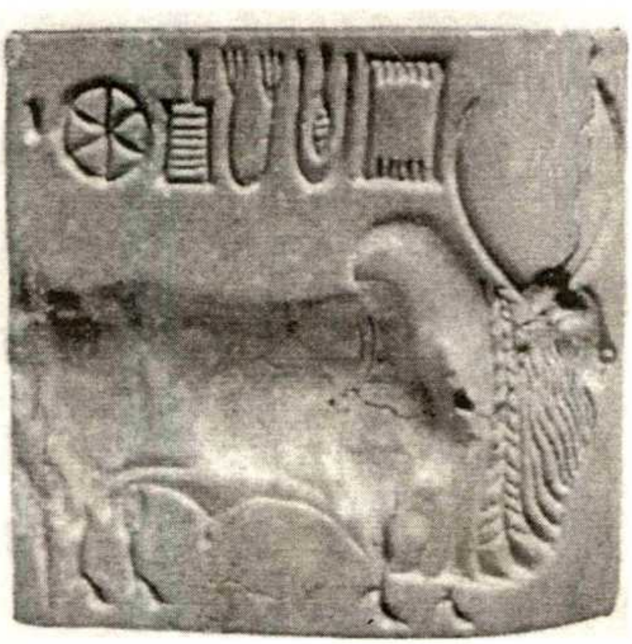


Fig. 19: Seal depicting a bull

Besides. it appears that Harappans used animal symbolism not just for religion but also for folk stories, as evidenced from depictions on pottery, and some of those stories are still told today (Rao 1991: 187; Lal 1998: 88-91).

Nowhere in all this do we feel an alien culture. Indeed in his 1931 report, John Marshall, who never doubted AIT, put it in a nutshell: "Taken as a whole, their [the Indus Valley people's] religion is so characteristically Indian as *hardly to be distinguished from still living Hinduism*" (1931: vi, emphasis added).

It is a sign of the times that if an Indian archaeologist states as much today, when far more evidence is available, he will be instantly criticized by blinkered scholars who continue to refuse to see anything Indian in Harappan culture.

Calcutta University Library ALIPORE CAMPUS

Yoga

In the end we must stress an important practice, and a distinctly Indian one, which seems to have run deeper than rituals — that of yoga. Besides the numerous seals representing deities in yogic postures (Fig. 20) and the series of figurines from Lothal in various *asanas*, we have from Harappa a striking figurine with joined hands (Fig. 21), in *anjali namaskar*. Moreover the so-called "priest king" is portrayed in deep contemplation and might more likely represent a *rishi*. "Yoga" as a word may not appear in the Rigveda, but the whole quest of the *rishis* towards immortality is nothing but yogic, if we will forget for a minute the crude notions of "primitive animism" (Thapar 1987: 43) which the nineteenth-century scholars and their descendants have sought to impose on the Vedic experience.

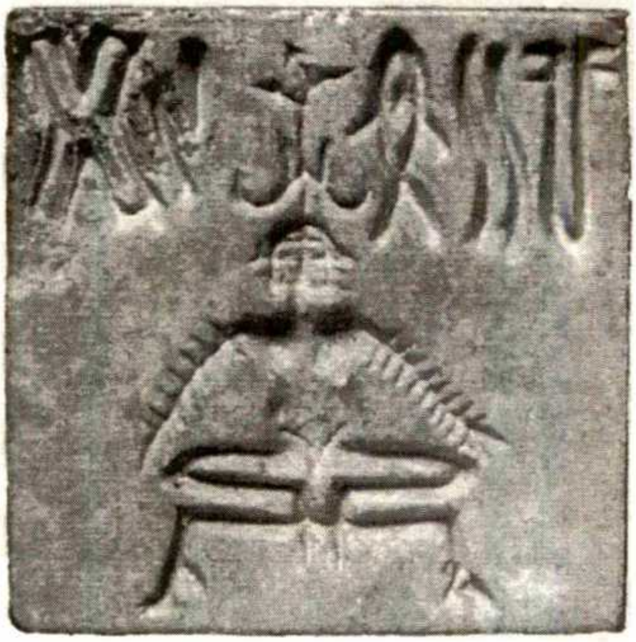


Fig. 21: Seal depicting a deity in yogic posture

Conclusions

Renfrew (1989: 190) summarized the whole issue thus: "It is difficult to see what is particularly non-Aryan about the Indus Valley civilization." The great paradox is that when `Aryan' concepts, rituals or customs such as those noted here come to light in the Indus-Saraswati civilization, we are told that the invading Aryans must have `borrowed' them from the Harappans. Thus as the evidence keeps accumulating, we find that the Aryans, who were earlier portrayed as archetypal conquerors imposing their culture on most of the Subcontinent, `borrowed' from the Harappans astronomy, an early form of the decimal system, forms of town planning, agricultural and metallurgic techniques, deities, yoga, the svastika, the conch and the *pipal*, and so forth — quite a miraculous U-turn from aggressive conquerors to compulsive borrowers! Devices such as the theory of a `double wave' of Aryan immigration (Allchin and Allchin 1997: 220-222), one of which might have taken place during mature Harappan times, are so clumsy and artificial that they are in themselves an admission of defeat, all the more so as they have no evidence to offer in support of two `waves' or even just one.

It is beyond the scope of this paper to examine the mechanisms of transmission of the Harappan heritage in the post-urban or "regionalization" phase, during which eastward and southward shifts of settlements took place. As Shaffer (1992: 459) remarked, "The previous concept of a 'Dark Age' in South Asian archaeology [after the mature Harappan phase] is no longer valid." "It is clear that this period of more than 700 years was not a chaotic 'Dark Age', but rather a time of reorganization and expansion," agrees Kenoyer (1995: 234), who sees between those two civilizations "no significant break or hiatus" (1998: 180). India's time-honoured tradition of a 5000-year continuum (much more if we include the early Harappan stages) is vindicated, not so the colonial straitjacket.

A word of caution in the end: while there does seem to have been a general backdrop of Vedic culture to the Harappan civilization, Harappan culture was not monolithic, and must have integrated many regional and tribal features and variations, as Hinduism has always done in historical times. Moreover, if the composers of the Vedic hymns were living in Harappan times, they may well have done so on the margins of that great civilization (perhaps in *ashram*-like settlements) rather than in the middle of its cities. Finally, despite convincing work by Kak (1988) pointing to a connection between the Harappan and the Brahmi scripts on the basis of frequency analysis, we are still yearning for the former's decipherment. If it ever comes (the discovery of longer texts would be a great help), then we should expect a Sanskritic language, of any sort, to complete the picture. Time will tell. After all, we have already waited some five millennia.

References

Agrawal, D.P. 1993. The Harappan Legacy: Break and Continuity, in *Harappan Civilization: a Recent Perspective* (G.L. Possehl Ed.), pp.??. New Delhi: Oxford and IBH.

Allchin, Raymond and Bridget Allchin 1997. *Origins of a Civilization – The Prehistory and Early Archaeology of South Asia*. New Delhi: Viking.

Basham, A.L. 1981. *The Wonder That Was India*. Calcutta: Rupa and Co.

Bisht, R.S. 1997. Dholavira Excavations: 1990-94, in *Facets of Indian Civilization: Essays in Honour of Prof. B. B. Lal* (J.P. Joshi Ed.), pp.??. New Delhi: Aryan Books International.

Bisht, R.S. 1999. Harappans and the Rigveda: Points of Convergence, in *Dawn of Indian Civilization (up to c. 600 B.C.)* (G.C. Pande Ed.), pp. ??. New Delhi: Centre for Studies in Civilizations.

Bryant, Edwin 2002. *The Quest for the Origins of Vedic Culture: The Indo-Aryan Migration Debate.* New Delhi: Oxford University Press (also 2001 New York: Oxford University Press).

Coningham, R.A.E. 1995. Dark Age or Continuum?, in *Archaeology of Early Historical South Asia-The Emergence of Cities and States* (F.R. Allchin Ed.), pp. ??. Cambridge: Cambridge University Press.

Elst, Koenraad 1999. *Update on the Aryan Invasion Debate.* New Delhi: Aditya Prakashan.

Erdosy, George 1994. The Meaning of Rgvedic *pur*: Notes on the Vedic Landscape, in *From Sumer to Meluhha* (Jonathan Mark Kenoyer Ed.), pp.??. Wisconsin: University of Wisconsin.

Gupta, S.P. 1996 *The Indus-Saraswati Civilization – Origins, Problems and Issues.* Delhi: Pratibha Prakashan.

Jarrige, Jean-François 1995. Du néolithique à la civilisation de l'Inde ancienne, in *Arts Asiatiques*, vol. L(1995). Paris : École Française d'Extrême-Orient.

Kak, Subhash 1998. A Frequency Analysis of the Indus Script, *Cryptologia* XII (3), July 1988.

Kennedy, K.A.R. 1982. Skulls, Aryans and Flowing Drains, in *Harappan Civilization – a Contemporary Perspective* (G.L. Possehl Ed.), pp.??. New Delhi: Oxford and IBH.

Kenoyer, Jonathan Mark 1995. Interaction Systems, Specialized Crafts and Cultural Change, in *The Indo-Aryans of Ancient South Asia* (George Erdosy Ed.), pp.??. Berlin and New York: Walter de Gruyter.

Kenoyer, Jonathan Mark 1997. Early City-States in South Asia: Comparing the Harappan Phase and Early Historic Period, in *The Archaeology of Early City-States: Cross-Cultural Approaches* (D.L. Nichols and T.H. Charlton Eds). pp.??. Washington, D.C.: Smithsonian Institution Press.

Kenoyer, Jonathan Mark 1998. *Ancient Cities of the Indus Valley Civilization.* Karachi and Islamabad: Oxford University Press and American Institute of Pakistan Studies.

Krishnamurthy, R. 1997. *Sangam Age Tamil Coins.* Chennai: Garnet Publications.

Lal, B.B. 1997. *The Earliest Civilization of South Asia.* New Delhi: Aryan Books International.

Lal, B.B. 1998. *India 1947-1997: New Light on the Indus Civilization.* New Delhi: Aryan Books International.

Lal, B.B. 2002. *The Sarasvati Flows On: The Continuity of Indian Culture.* New Delhi: Aryan Books International.

Mackay 1943******

Mainkar, V.B. 1984. Metrology in the Indus Civilization in *The Frontiers of the Harappan Civilization* (B.B. Lal and S.P. Gupta Eds.), pp.??. New Delhi: Books and Books.

Malville, J. McKim and Lalit M. Gujral 2000. *Ancient Cities, Sacred Skies: Cosmic Geometries and City Planning in Ancient India.* New Delhi: Indira Gandhi National Centre for the Arts and Aryan Books International.

Marshall, John 1931. *Mohenjo-daro and the Indus Civilization*, Vol. I. London.

Misra, V.N. 2001. Review of B.B. Lal's *The Saraswati Flows On: the Continuity of Indian Culture, Man and Environment* 26(2): 123-126.

Parpola, Asko 2000. *Deciphering the Indus Script.* New Delhi: Cambridge University Press.

Rao, S.R. 1991. *Dawn and Devolution of the Indus Civilization.* New Delhi: Aditya Prakashan.

Renfrew, Colin 1989. *Archaeology and Language – the Puzzle of Indo-European Origins.* London: Penguin Books.

Sarasvati Amma, T.A. 1999. *Geometry in Ancient and Medieval India.* New Delhi: Motilal Banarsidass.

Sarkar, H. and B.M. Pande 1999. *Symbols and Graphic Representations in Indian Inscriptions.* New Delhi: Aryan Books International.

Sergent, Bernard 1997. *Genèse de l'Inde.* Paris: Payot.

Shaffer, Jim G. 1984. The Indo-Aryan Invasions: Cultural Myth and Archaeological Reality, in *The People of South Asia – the Biological Anthropology of India, Pakistan, and Nepal* (J.R. Lukacks Ed.), pp.??. New York and London: Plenum Press.

Shaffer, Jim G. 1992. The Indus Valley, Baluchistan, and Helmand Traditions: Neolithic through Bronze Age, in *Chronologies in Old World Archaeology* I (Robert W. Ehrich Ed.), pp.??. Chicago and London: The University of Chicago Press.

Sri Aurobindo 1971. *The Secret of the Veda*. Pondicherry: Sri Aurobindo Ashram.

Thapar, Romila 1987. *A History of India* Vol. I. London: Penguin Books.

Thapar, Romila 2000. Hindutva and History, *Frontline* 13 October 2000. Chennai.

Trautmann, Thomas R.1997. *Aryans and British India*. New Delhi: Vistaar Publications.

Wanzke, Holger 1987. Axis Systems and orientation at Mohenjo-daro, in *Interim Reports* Vol. II (M. Jansen and G. Urban Eds.), pp. ??. Aachen: Aachen University Mission.

Metallurgical Investigations on a Chalcolithic Copper Nail from Balathal

A. Srivastav, R. Balasubramaniam[1] and V.N. Misra[2]

Department of Materials and Metallurgical Engineering
Indian Institute of Technology
Kanpur 208 016

[1] bala@iitk.ac.in

[2] G-2, B Wing, Ganga Park
Mundhwa Road
Pune 411 036

Abstract

A Chalcolithic (2350-1800 B.C.) copper nail from Balathal has been characterized by X-ray diffraction, microstructural and electrochemical methods. The surface patina was composed of sulphates and oxysulphates in the outer layers while the inner layers were rich in copper oxides. The nail exhibited smaller grain sizes near two of the surfaces while the structure in the interior was equiaxed. The deformed grains and inclusions near the surfaces and variation in the micro-hardness of the sample from different faces proved that the copper nail was processed by cold deformation after initial casting of the square cross-section nail. The electrochemical behaviour of Chalcolithic Cu has been compared with that of a modern Cu sample by potentiodynamic polarization studies. The corrosion rate of Chalcolithic Cu in aerated 3.5% NaCl solution was only marginally higher than that of modern Cu. The higher rate of corrosion has been attributed to the presence of second phase sulphide inclusions. The excellent condition of preservation of the 3800 year old copper object, with no indications of stress corrosion cracking, suggests that pure copper or copper-based materials can be seriously considered as candidate canister materials for long-term underground storage of nuclear wastes in underground repositories.

Introduction

Recent excavations at Balathal in Udaipur District have revealed that it could be the oldest known village outside the domain of the Indus (Harappan) civilization (Misra *et al.* 1995; Misra *et al.* 1997). Radiocarbon studies have provided firm dates between 2350 and 1800 B.C., thereby placing it as a Chalcolithic site (Misra *et al.* 1995). Balathal is one among the several Chalcolithic sites discovered in the Mewar region of south Rajasthan. The characteristic features of this culture are a variety of ceramics, beads of semi-precious stones and terracotta and animal figurines, copper technology, absence of stone blades and microliths, and an economy based on plant cultivation, animal husbandry, and limited hunting and fishing (Misra *et al.* 1995). Excavations have revealed two cultural periods at Balathal — the Chalcolithic and Iron Ages. It appears that the settlers of Balathal came into contact with Harappan people of Gujarat after establishing their settlement. After an occupation lasting several centuries, the Chalcolithic settlement at Balathal was abandoned around 1800 B.C. for reasons yet unknown. The same locality was reoccupied after a gap of more than 1200 years in the Iron Age by a new group of people, who used iron technology and possessed a different material culture. The reoccupation of the site suggests its importance as a strategic location. The evidence for iron smelting and the manufacture of iron implements at the site further suggests its economic importance in the later Iron Age. The tools and weapons of the Chalcolithic people of Balathal, however, were mainly made of copper. The Harappan influence was noted in the copper implements (barbed arrowheads, knives, chisel, chopper, nail) discovered at Balathal as they were similar to those found in association with Harappans. The mode of manufacture of these copper objects into desired shapes needs to be understood. The Balathal site is close to Ahar (~35 Km) from where the inhabitants could have obtained copper implements (Misra *et al.* 1995, 1997). It has also been suggested that, as the site is close to copper ore deposits, the Chalcolithic people could have exploited them (Misra *et al.* 1995). It is interesting to note that small stone blades and tools were completely absent at Balathal, but seen in all other Chalcolithic sites. This clearly suggests that copper metal was plentifully available. In fact, a fireplace excavated inside a structural complex has been suggested as being a furnace for smelting and working copper (see fig. 8 of Misra *et al.* 1995).

Several copper tools and weapons were discovered in the Chalcolithic site of Balathal. In the present investigation, a copper nail (see fig. 11 of Misra *et al.* 1995 for a picture of the copper nail) from Balathal was addressed by a detailed metallurgical investigation. Metallurgical investigations on ancient copper provide valuable insights on the long-term corrosion and degradation behaviour of copper. These valuable archaeological analogues assist in the selection and design of materials for long-term corrosion resistance, like those required for long-term underground storage of nuclear wastes. Copper is one of the natural materials of choice and investigations on archaeological copper would provide valuable inputs in material selection for canisters for long-term nuclear waste storage (Rosborg *et al.* 2003). In this regard, the inputs from archaeologists would provide valuable insights in the materials selection problem.

Experimental Procedure

The copper nail that was utilized in the present study was of square cross-section at one end, tapering down to a smaller flatter cross-section at the other. Its total length was 9 cm and cross-section at the square section was 0.86 cm by 0.86 cm. It was covered with an adherent surface patina, which appeared light green in colour. A small section was made at the square cross- section end using a diamond cutter. Samples of pure modern copper were also prepared for comparison. Three samples were prepared from this section. The first sample was utilized for metallographic (optical and scanning electron microscopy) and micro-hardness measurements. The second sample was specifically maintained for X-ray diffraction (XRD) analyses. The third sample was mounted for electrochemical analysis. While cutting the samples, special care was taken to ensure that the surface scales (i.e. the corrosion products) were not disturbed, especially in the sample utilized for XRD analysis. The specimen for metallographic observations was hot mounted. Special care was taken during mounting to maintain the flatness of the sample and the mount. The cross-section of the nail was the section observed on the microscope. The sample was ground and polished very carefully to avoid the reappearance of new scratches. The final polishing was performed with 1 mm diamond paste. The specimen was etched in ferric chloride solution for revealing the microstructure. The microstructures were observed using an optical microscope (Axiolab A, Zeiss, Germany) and a JEOL 840A scanning electron microscope (SEM). The images from the optical microscope were recorded using a digital camera (CE, Japan) and later analysed in an image analysis program (Image-Pro Plus 4.1, Media Cybernetics, USA). The volume fraction of the inclusions and the grain sizes were estimated. In order to measure the volume fraction, 30 fields of view (FOV) were captured (at a magnification of 200X) and analysed. A 15 x 11 grid was imposed on each of the FOVs. The number of points falling in the feature of interest was calculated manually and divided by the total number of grid points to provide the volume fraction. The linear intercept method was used for measuring the grain size. Thirty FOVs were captured and nine test lines were imposed on each of the FOVs using the software. The number of intersections between the test lines and the grain boundaries were counted. The total length of test lines divided by the total number of intersection points provided the grain size. Thirty FOVs help to minimize statistical error.

The sample for electrochemical analysis was mounted in a cold setting epoxy, after soldering a conductive wire to it. Electrochemical polarization experiments were conducted utilizing a potentiostat (263A Perkin Elmer, USA). Polarization studies were carried out in 3.5 wt % NaCl solution. The samples were polished to 4/0 grade emery paper finish and the surfaces were cleaned using distilled water and acetone before the start of each experiment. A round-bottom polarization cell, with graphite counter electrodes and saturated calomel electrode (SCE) (+241 mV vs standard hydrogen electrode) reference electrode, was used in the electrochemical study. Potentiodynamic polarization experiments were conducted after stabilization of free corrosion potentials. Both Chalcolithic Cu and modern Cu samples were tested. Corrosion rates were determined by the Tafel extrapolation and linear polarization methods. A scan rate of 1 mV/s was used for potentiodynamic polarization experiments and 0.166 mV/s for Tafel extrapolation, as per ASTM standards (ASTM 1987). In the case of Tafel extrapolation experiments, the potential was scanned from –250 mV to +250 mV with respect to the free corrosion potential (FCP), while in the case of linear polarization experiment, it was scanned from –50 mV to +50 mV with respect to FCP.

The micro-hardness variation, as a function of distance from the surface, was obtained from the four surfaces of the cross-section .The micro-hardness experiments were performed in a Carl Zeiss Jena 160 micro-hardness tester using a 60 g load. The hardness was measured across a line perpendicular to the surface, from the edge progressing towards the middle of the specimen, at systematic intervals. Six profiles were recorded from each of the four specimen surfaces and the average estimated for each of the point.

The X-Ray diffraction (XRD) experiments were conducted in a Rich-Seifert X-ray Diffractometer, taking special care to maintain the same conditions for all the experiments (constant current of 20 mA and voltage of the X-ray tube 30 kV). The wavelength of the radiation used was Cu K_α (1.54184 Å). The XRD patterns were analysed using DIFFRAC^{plus} Software (Bruker Advanced X-Ray Solutions) and JCPDF database (JCPDF 2001). XRD patterns were first obtained from all the surfaces, and later, were again determined after slightly polishing off the surface layers using fine emery paper. It was not easy to identify the peaks due to high amount of noise and texturing and in this regard the DIFFRAC$^{\text{plus}}$ software was very useful in removing some noise and texturing effects.

Results and Discussion

X-Ray diffraction analysis

The XRD patterns obtained from all the four faces of the as-received material were similar, barring some very minor variations. This indicated that the environment, to which the copper nail was exposed to, was uniform. A typical diffraction pattern obtained from the surface is shown in Fig. 1a. The peaks were compared with that of the common corrosion products of Cu (JCPDF 2001). Apart from peaks due to the substrate Cu, all the other peaks could be indexed unambiguously to specific corrosion products. It was firmly concluded that the major corrosion products on the surface of the sample were hydrated copper sulphates and oxysulphates (Fig. 1a). The specific phases identified were $Cu_4(SO_4)(OH)_6.2H_2O$ posnjakite (JCPDF 43-0670), $CuSO_4.H_2O$ (JCPDF 80-0392), $Cu_3(SO_4)_2(OH)_2$ (JCPDF 37-0526) and $Cu_3(SO_4)_2(OH)_2.4H_2O$ (JCPDF 37-0525).

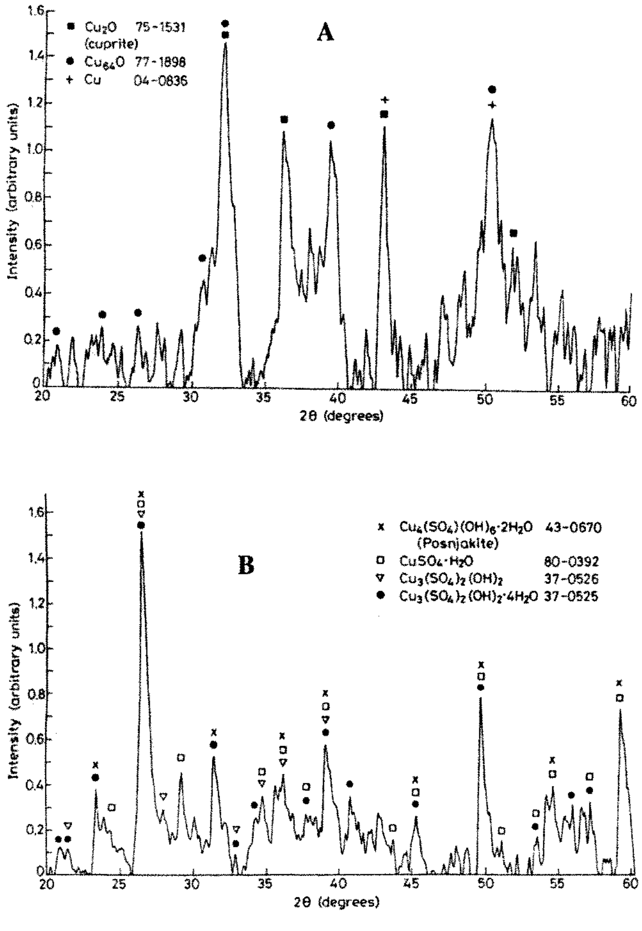


Fig. 1: X-ray diffraction pattern from the surface of the Chalcolithic Cu sample (a) before, and (b) after slightly polishing the surface of the sample. The peaks corresponding to the identified phases have been marked in both the patterns.

The XRD patterns were re-determined after slight polishing using emery paper. The XRD patterns from all the surfaces were again similar. A typical pattern after the polishing procedure is shown in Fig. 1b. Analysis of these XRD patterns revealed that the phases were primarily copper oxide phases (Fig. 1b). The identification of peaks corresponding to $Cu_{64}O$ is interesting because it indicated that a sub-oxide, rich in Cu, was present and this must be present below the cuprite (Cu_2O) phase in the patina. The peaks from the Cu matrix were relatively more intense than in the earlier case (Fig. 1a). This indicates that the information provided in Fig. 1b would apply to the nature of corrosion products near the metal-scale interface. The XRD patterns obtained before polishing and after polishing of the sample surface helps in understanding sequence of formation of corrosion products. The results of the analysis agree with the known general behaviour for corrosion of copper in soil environments (Leygraf and Gradel 2000). In the corrosion of copper in soil (and also atmospheric environments), the first product to form is cuprite. In the presence of sulphur in the environment, the formation of sulphates and oxysulphates is favoured and these phases are generally found above the copper oxide-containing layer. This behaviour has been also observed in the present case of the Chalcolithic copper nail.

Microstructural analysis

The microstructure of the sample was analysed using an optical and a scanning electron microscope (SEM). Photographs at different magnifications were obtained from different locations in the sample. Microstructural analysis revealed an almost equiaxed microstructure containing entrapped second phase inclusions in the centre of the sample (Fig. 2a). Some of the grains revealed deformation twins (Fig. 2b). The entrapped second phase inclusions were generally spherical in shape in the centre, whereas some inclusions, especially those near the edge of the sample, were deformed. The etching in some grains was non-uniform due to coring effects, similar to that observed in an OCP Cu object studied earlier (Balasubramaniam *et al.* 2002). These coring effects result during the initial casting of the object. As they were not removed in the sample, it indicates that the Cu nail has been initially cast into shape.

The microstructure was not completely homogeneous as the microstructure from near two opposite surfaces of the sample was quite different (Fig. 3a-c). The grains were of relatively smaller size and more deformed compared to the grains in the interior. These microstructures reveal a cold-worked structure with numerous slip bands. It can be deduced from these microstructures is that the initially cast nail had been cold-worked to provide the final shaping operation to the nail. It is also interesting to note the possible reason why the shaping operation was provided on

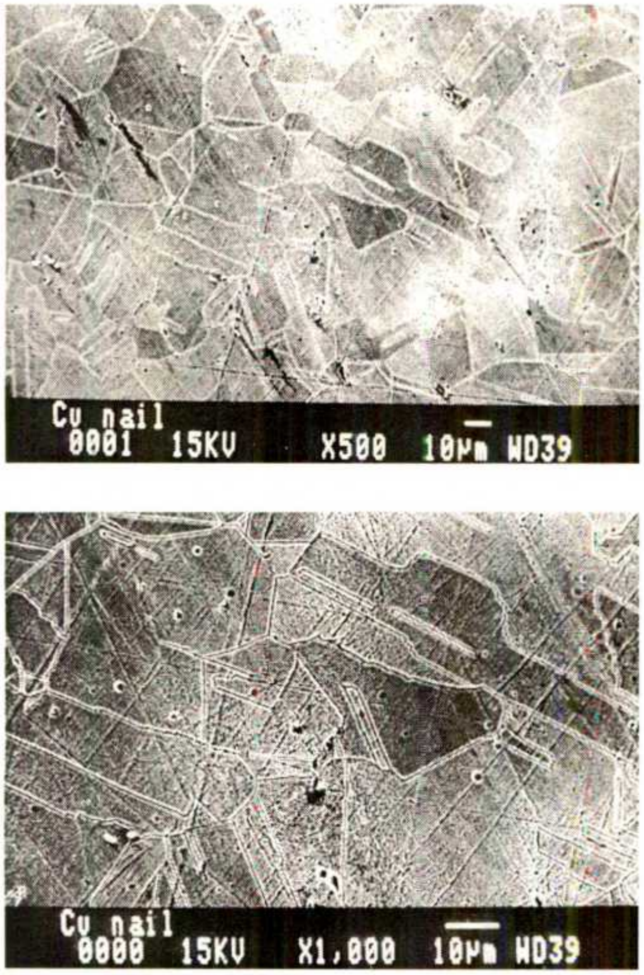


Fig. 2: SEM micrographs obtained from the centre of the nail cross-section showing entrapped second phase spherical inclusions inside the grains. Also deformation twins can be observed in some of the grains.

only two opposite faces and not on all the four. This was because the nail was finally hammered to the shape of a flat edge and for this, deformation of only two faces was required. Therefore, based on the microstructural observations, it can be concluded that the Chalcolithic Cu nail was initially cast and later was cold-worked to give it the required shape.

Interestingly, there were no stress corrosion cracks emanating from the edges or corners of the sample. Some features of corrosion attack can also be observed in the microstructures obtained from the edges (Fig. 3). The microstructures (Fig. 3a-b) from near the edge of the sample show the corrosion layer on right side of the photograph. The incursion of corrosion products into the matrix appears to occur along grain boundaries of the underlying matrix. (Fig. 3b-c). The intergranular nature of corrosion attack is understandable because of the higher-energy state of material at these locations. Nevertheless, it

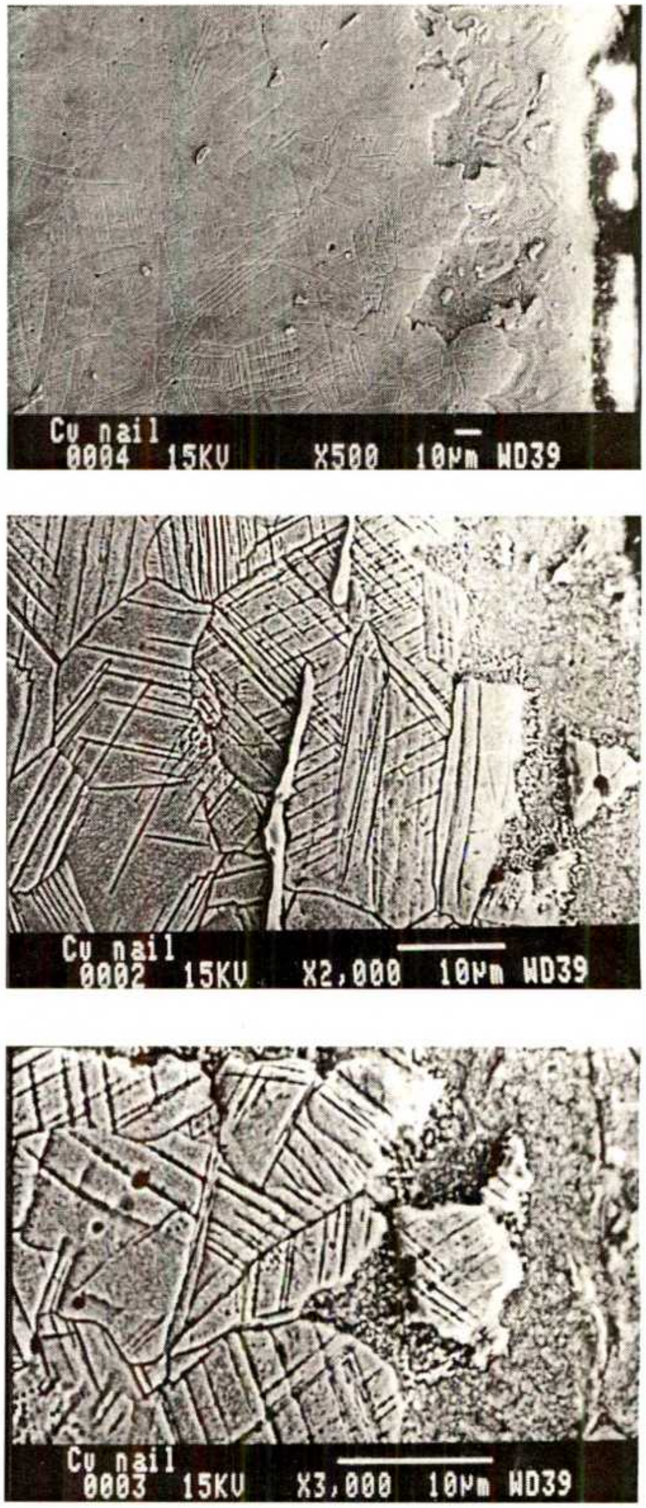


Fig. 3: SEM micrographs photographed from one of the edges of the sample, showing deformed grains and incursion of corrosion products along grain boundaries. Corrosion layer is on right side of the photograph. Elongated bright slag inclusion can also be seen in (a).

is also important to note that the incursion of corrosion products along the grain boundaries was not deep enough to warrant the use of the term pitting to describe this kind of environmental corrosion. A complementary conclusion is the lack of any environmentally induced cracking in this material. This is understandable because dangerous chloride ions were not present in the soil environment to which the nail was exposed. This conclusion is based on absence of chlorides in the surface patina (Fig. 1a-b). Therefore in the environments where chloride ions are excluded, like in the present study, microstructural investigations on archaeological copper provide that there is no danger of stress corrosion cracking. This observation has important implications in the selection of Cu as the material for long-term nuclear storage canisters.

Microstructural analysis of the Chalcolithic Cu also revealed second phase inclusions (Fig. 2), which appeared dark in the optical micrograph. In case of pure modern Cu, second phase inclusions were not observed. The entrapped inclusions were elongated near the edges of the sample, indicating that the slag particles were amenable to deformation at room temperature without cracking (Fig. 3b). It is important to note that deformation was noticed only on two sides of the sample, thereby suggesting the possible mode of manufacture of the copper nail. The elongated slag inclusions were parallel to the surface and such inclusions were not observed inside the sample. The entrapped inclusions in the middle of the sample were spherical (Fig. 2b). The entrapped inclusions were analysed for their compositions in an electron probe microanalyser. The second phase inclusions that appeared bright in the back-scattered electron image were confirmed to be pure Pb. By using back-scattered electrons for imaging in the scanning electron microscope, atomic number contrast is obtained with high atomic number elements appearing brighter than low atomic number elements. The darker appearing inclusions in the bright field image were analysed to contain Cu, Fe, Pb and S, indicating that they were essentially sulphides of Cu with Pb sulphide and Fe sulphide occurring as impurities. The composition of the matrix was essentially pure Cu, with trace amounts of As and Sn. In order to obtain some insights, the entrapped slag inclusions were observed. The second phase inclusions in an OCP Cu were earlier analysed in an electron probe microanalyser as sulphides of Cu and Pb (Balasubramaniam *et al.* 2002). This seems to indicate that the technology for copper extraction and application remained almost similar for a large period in Indian history based on the analysis of the Chalcolithic (2350-1800 B.C.) and OCP (2650-800 B.C.) copper samples.

The volume fraction of second phase inclusions and the grain size were determined as per the procedure discussed earlier. The image analysis results are tabulated in Table 1. The volume fraction of inclusions was relatively low and almost similar to that of OCP Cu analysed earlier (Laha *et al.* 2002), thereby suggesting similarities between the OCP and Chalcolithic copper samples. The grain size of Chalcolithic Cu was slightly lower compared to modern Cu or OCP Cu, suggesting that the Cu nail was subjected to deformation by hammering action. This was also confirmed by microstructural analysis.

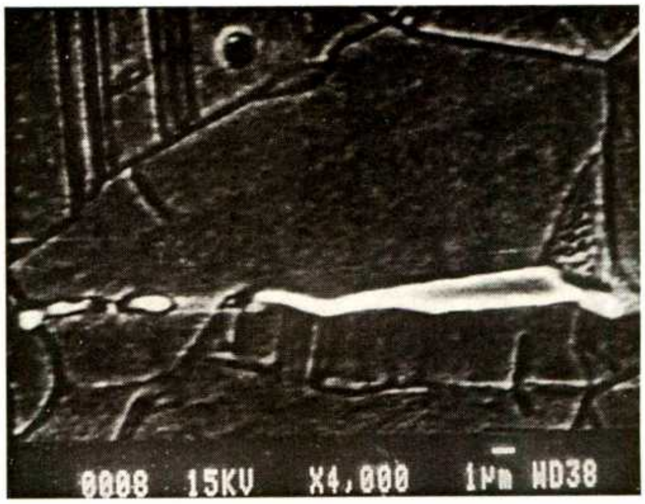


Fig. 4: SEM micrograph obtained using back-scattered electrons indicating that Pb must be present in the second phase inclusion

Micro-hardness

The variation of micro-hardness as a function of distance into the material from the surface is shown in Fig. 5. The hardness profiles were almost constant on two opposite faces, while on the remaining two, the hardness was much higher near the surface, which progressively decreased on moving towards the interior (Fig. 5). The hardness of the

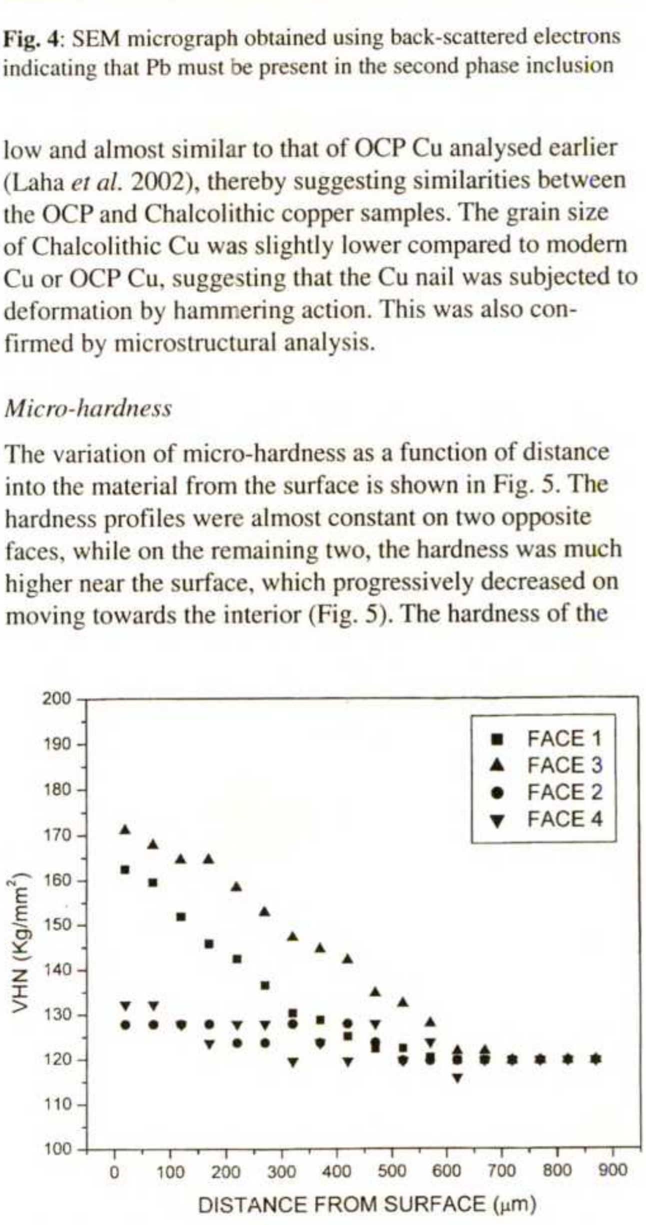


Fig. 5: Variation of micro-hardness as a function of distance into the surface from all the four surfaces

Table 1: Volume fraction of inclusions and grain size, calculated by image analysis

Copper Sample	**Volume fraction**			**Grain size**		
	% V_v	**Std Dev**	**% error (±)**	**Size (mm)**	**Std Dev**	**% error (±)**
Modern	—	—	—	19.47	1.57	2.95
Chalcolithic	2.78	0.59	7.68	14.10	2.66	6.88
OCP	2.11	0.90	11.02	19.50	3.79	7.09

matrix in the centre was almost similar for all profiles. The micro-hardness measurements confirmed deformation on two opposite surfaces. On the other two surfaces, there was no significant variation in the hardness from surface to the middle of the specimen.

Electrochemical characterization

Electrochemical behaviour provides valuable information about corrosion resistance. Copper canisters have been proposed for long-term storage of nuclear wastes deep inside the ground (Rosborg *et al.* 2003). It is therefore important to know if Cu would be resistant to corrosion over very long period of time, because the long-lived nuclear wastes have to be stored for more than 10,000 years (Rosborg *et al.* 2003). It is in this context that archaeological analogues can provide valuable information regarding the expected behaviour of copper canisters for long-term nuclear waste storage. The copper sample used in the study was a very old and of conservative age of 3800 years. From microstructural analysis it has been found that the degree of corrosion was not severe and moreover, stress corrosion cracking was not evident from the surfaces of the sample. Electrochemical characterization will reveal information about its corrosion properties, which can be compared with that of modern Cu.

The free corrosion potential of the Chalcolithic copper sample stabilized relatively quickly on immersion in the electrolyte. This indicates that equilibrium corrosion conditions (i.e. supporting anodic and cathodic reactions) are established fairly quickly on the surface of this sample. This behaviour was similar to that observed for modern Cu. Therefore, the entrapped slag inclusions in Chalcolithic Cu do not deleteriously affect the establishment of equilibrium corrosion conditions on the surface, which is understandable as the volume fraction of entrapped inclusions was relatively low (Table 1). The potentiodynamic polarization curves for modern and Chalcolithic Cu samples in 3.5 wt % NaCl solution are shown in Fig. 6. Both the copper samples exhibited similar electrochemical behaviour in the NaCl solution. The polarization behaviour of modern Cu was in excellent agreement with published data (Trethewey and Chamberlain 1988). The surface film that formed at anodic potentials was very stable because no pitting was observed even up to +1400 mV vs SCE. A thin adherent surface film was visually observable in both the samples even after removal from the solution, at the end of each experiment. The various potentials like zero current potential, primary passivation potential, etc. were similar for the samples indicating that the entrapped slag inclusions did not significantly affect polarization behaviour.

The major difference between the two samples was the presence of second phase inclusions in the case of the Chalcolithic Cu sample. It was anticipated that the presence of second phase inclusions would affect the corrosion rates. Table 2 presents the results of Tafel extrapolation method for modern, Chalcolithic and OCP coppers. The

Table 2: Results of Tafel extrapolation experiments

Copper Specimen	**β_c (mV/dec)**	**β_a (mV/dec)**	**i_{corr} ($\mu A/cm^2$)**	**Corrosion rate (μm /y)**	**Zero Current Potential (mV vs SCE)**
Modern	-26	21	0.49	55	-226
Chalcolithic	-32	37	0.63	175	-172
OCP	-28	37	0.67	185	-194

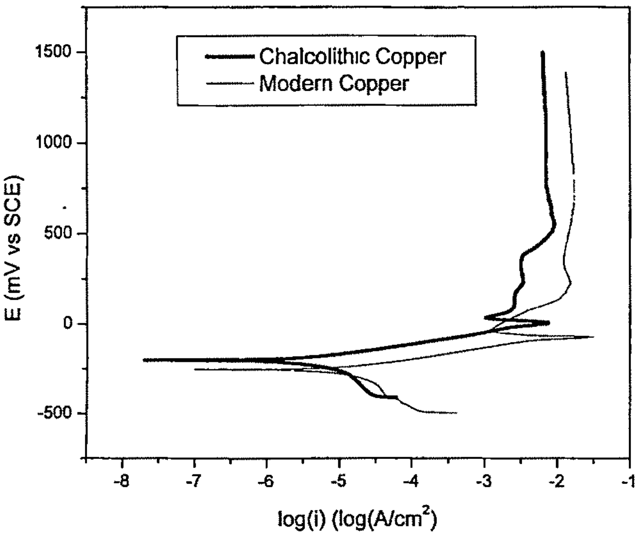


Fig. 6: Potentiodynamic polarization curves for modern and Chalcolithic coppers in aerated 3.5 wt % NaCl solution

anodic and cathodic Tafel slopes were almost similar for the three samples, which is reasonable. The corrosion rate of Chalcolithic Cu sample (175 mm/y) was marginally higher than modern Cu (55 mm/y). The corrosion rate for modern Cu agreed well with the published corrosion rate for Cu in seawater (25-127 mm/y) (LaQue 1975). The second phase slag particles appear to have slightly enhanced the dissolution tendencies, which could probably be due to galvanic coupling action of the Cu matrix with the slag inclusions. It is to be noted that the sulphides are electrically conducting and they aid in the establishment of local galvanic cells (Wranglen 1969). The effect of the inclusions was not significant because the volume fraction of inclusions was relatively low and, moreover, they were not interconnected but widely dispersed (Fig. 2). In order to double-check the calculated corrosion rate from the Tafel extrapolation technique, the corrosion rate of Chalcolithic copper was also determined using the linear polarization technique. The corrosion rates was an order of magnitude lower, possibly due to the presence of unreduced surface film on the surface of the sample compared to the Tafel experiment where the specimen was polarized to a larger cathodic over potential.

Conclusions

The microstructure of the material of construction of a Chalcolithic (2350-1800 B.C.) copper nail from Balathal has been characterised by stereological methods. The smaller grain size, deformed grains and deformed inclusions near the surfaces and variation in the micro-hardness of the sample at different points suggests that the copper nail was processed by cold deformation after casting of the square cross section nail. The electrochemical behaviour of Chalcolithic Cu has been characterized and compared with that of a modern Cu sample by potentiodynamic polarization studies. The corrosion rate, determined by Tafel extrapolation technique in 3.5% NaCl solution, of Chalcolithic Cu was only marginally higher than that of modern Cu. The higher rates of corrosion in case of OCP Cu has been attributed to the presence of second phase sulphide inclusions.

Acknowledgements

The authors would like to thank the Archaeological Museum, Deccan College, Pune for providing the Chalcolithic copper nail sample used in the present study.

References

ASTM 1987. *Metals Test Methods and Analytical Procedures*. Annual Book of ASTM Standards, Volume 3.02(3), Philadelphia, USA.

Balasubramaniam, R., M.N. Mungole, V.N. Prabhakar, D.V. Sharma and D. Banerjee 2002. Some Metallurgical Aspects of An OCP Period Copper Hoard, *Man and Environment* XXVI(2): 89-97.

JCPDF 2001. Powder Diffraction Files, Joint Committee on Powder Diffraction Standards – International Centre for Diffraction Data, Swarthmore, USA.

Laha, T., J. Shankar, R. Balasubramaniam, A. Tewari, V.N. Prabhakar, D.V. Sharma and D. Banerjee 2002. Material and Electrochemical Characterization of Ancient Indian OCP Period Copper, *Indian Journal of History of Science* 37: 320-329

LaQue, F. L. 1975. *Marine Corrosion - Causes and Prevention.* New York: John Wiley.

Leygraf, C. and T. Graedel 2000. *Atmospheric Corrosion.* New York: Wiley-Interscience.

Misra, V.N., Vasant Shinde, R. K. Mohanty, Kurush Dalal, Anup Mishra, Lalit Pandey and Jeevan Kharakwal 1995. Excavations at Balathal: Their Contribution to the Chalcolithic and Iron Age Cultures of Mewar, Rajasthan, *Man and Environment* XX (1): 57-80.

Misra, V. N., Vasant Shinde, R. K. Mohanty, Lalit Pandey and Jeevan Kharakwal 1997. Excavations at Balathal: Udaipur District, Rajasthan (1995-97), with Special Reference to Chalcolithic Architecture, *Man and Environment* XXII (2): 35-59.

Rosborg, B., O. Karnland, G. Quirk and L. Werme 2003. Measurements of Copper Corrosion in the LOT Project at the Aspo Hard Rock Laboratory, Proceedings of the *International Workshop on*

Prediction of Long Term Corrosion Behaviour in Nuclear Waste Systems, European Federation of Corrosion, Series 42. (in press).

Trethewey, K. R. and J. Chamberlain 1988. *Corrosion for Students of Science and Engineering*, Harlow: Longman Scientific.

Wranglen, G. 1970. *Corrosion Science* 9: 585-601.

Archaeology of the Pudukottai Region, Tamil Nadu

K. Rajan

Department of Archaeology
Tamil University
Thanjavur 613 005
rajanarchy@eth.net

Abstract

This paper reports the intensive explorations undertaken in Pudukottai region of Tamil Nadu that has a large number of Megalithic monuments, Jain centres and rock-shelters with Tamil-Brahmi inscriptions. The presence of Megalithic monuments in close vicinity to irrigation tanks suggests a relationship between Megalithic people and the tank based irrigation. The paper attempts to explore the various factors involved in the emergence of the Early Historic culture in this region.

Introduction

Under British rule Pudukottai was one of the five princely states in what is now Tamil Nadu. It merged with Indian Union in 1948 as part of Thiruchchirapalli District and became a separate district on 14th January 1974. Although, few excavations were done in the pre-Independence era, exploration work, both epigraphical and archaeological, was extensive. In fact, the largest number of monuments protected by the Pudukottai state falls in this district. This early archaeological work helped in the preservation of our cultural heritage. The recent spurt in the stone quarry and granite polishing industry has disturbed or completely destroyed some of the monuments. With an aim to record the surviving archaeological sites, an intensive exploration has been undertaken by the author.

Physiography

Pudukotttai District is like a starfish (between 9° 50' N-10° 44' N and 78° 25' E-79° 16' E) coverings an area of 4650 km^2. It lies in the intermediate zone between the slopes of ancient rock and the coastal lands fringing the sea. The western and the eastern parts of the district, separated by an imaginary north-south line passing through Pudukotttai town are distinctly different. The land west of this line comprises the greater portion of the Kulattur and Tirumayam taluks, which contain Archaean outcrops. The land east of the line comprising the Alankuti, Pudukotttai, Arantangi and parts of Tirumayam taluks has an alluvial cover. Gneisses are the basic metamorphic rock, consisting of amphibolites (a dark coloured rock having hornblende and plagioclase feldspar), granulite and pyroxenites (a mono-mineralic rock with or without, olivine). Among the hills, Piranmalai (the district's highest), Narttamalai, Aluruttimalai at Ammachattiram and Cevalurmalai are some of the hills of this district. Besides, there are minor hills like Viralimalai, Kudumiyanmalai, Malaiyakkoil and Malayatipatti.

No minerals of economic significance have been identified in this district except magnetite quartzite containing iron. Three broad types of soils are found in this district: red sterile soil, river alluvium and saline coastal alluvium. In the traditional classification of soils, the chief soil type in the tract is *cevval* (red soil), *karical* (black soil or *regur*), *kalar* (saline soil) and *patukai* (river alluvium). Red sterile soil occupies the major part of the district particularly the hilly terrain of the western part. River alluvium occurs in patches in the irrigated area of rivers and tanks. Saline soil forms in the coastal area. On the whole, the district does not have soil with good productivity.

The district has a hot tropical climate, humid near the coast. The summer season is from March to May. The southwest monsoon season lasts from June-September. The northeast monsoon lasts from October-November. The average rainfall is 921.8 mm. The temperature fluctuates from 37 to 43 °C with average temperature of 26 °C.

Drainage System

The most significant stream is the Vellaru, which served as a traditional border between Pandya and Chola territories. It rises in the Velamalai near Marungapuri in Thiruchchirapalli District and enters the Bay of Bengal near Manamelkudi after traversing Minaveli, Kudumiyanmalai, Peraiyur, Katayakkudi, Vetanatu and Kovilkottai. Out of a total length of 126 km, nearly for 96 km the river flows through Pudukottai District and the remaining in Thiruchchirappalli District. Several irrigation tanks are fed from its waters. An anicut constructed across this river at Kudumiyanmalai diverts the Vellaru waters to the tanks at Visalur, Vayalokam, Perumanadu and Kavinadu. The last mentioned tank, one of the biggest tanks of this district, is constructed near Pudukottai and also gets some water from an *anicut* on the Vellaru near Sentamangalam.

Interestingly most of the small rivers in this district originate from tanks. The Pamparu (snake river) has its origin in the outflows of the Perundurai tank in Tirumayam taluk. The most important tank fed by the Pamparu is the one at Irumpanatu in Tirumayam taluk. The masonry anicuts across the river at Netunkai supply water to a series of tanks near Kilanilai fort. It joins with Vellaru near Arantangi. Like Pamparu, other small streams like Perunkalaru (Agniaru) originates from Kulattur tank, Ampuliyaru from Manjakkanmai, Koraiyaru from Tenampati tank near Virlimalai and Kundaru from Kavinattu kanmai. The origin of the above streams clearly suggests that the Pudukottai District is studded with tanks.

The district has 5128 irrigation tanks. Kulattur taluk has the largest number among the taluks (1968), followed by Tirumayam (1595), Pudukottai (533), Arantangi (531) and Alangudi (501). Among the 5128 tanks, rivers feed nearly 115 tanks whereas the remaining 5013 tanks are rain-fed. Most of these tanks were created by bunding to collect and store rainwater that was let out in regulated amounts to irrigate fields on either side of the bund. Because these tanks empty themselves *(maittal)* through sluices let through the bund *(kan)*, they came to be called *kanmai*. The *kanmai* follows a regular pattern bunding areas at the various stages and contours of the slope from the high ground or foothills to the river valleys. They are so located that the surplus of one flows into the next. Most of the Megalithic monuments are close to the tanks.

The intensive explorations carried out in the region yielded 125 sites (Table 1), which include habitation-cum-burial sites, cairn circles, stone circles and urn burials (Fig. 1). Besides this, special attention is paid to sluice inscriptions. In total, 52 sluice inscriptions were brought to light in this district alone (Table 2). In the present exploration, no significant Palaeolithic tools were found. However, Sir Alexander Tottenham, an administrator of then Pudukottai State, reported a waste flake of cherty-flint (evidently struck off while making an artefact) on the bund of the *avikanmai* built close to Kuruvikavundanpatti near Rangiyam in 1940. Likewise, there are hardly any Neolithic sites in this region although we collected Neolithic celts from the Megalithic graves at Melappanaiyur (Fig. 2). In 1917. Venkatarangam Raju also collected two Neolithic tools from the urn at Mottaimalai (Ayyar 2002a: 523; Gandhi 1983: 110). Besides the collection of Neolithic celts, which come from Megalithic contexts, this region did not yield any Neolithic deposits. Abundant evidence for the Megalithic period is seen however.

Megalithic Culture

A large number of Megalithic burial sites were found in the water-spread area of irrigation tanks or close to the tanks (Fig. 3). This clearly demonstrates that most of the tanks that are still being used in this district have a long history. Tank irrigation may have started in Megalithic times. The occurrence of hundreds of burials as seen at Thayinipatti, Vayalokam, Singattakurichi and a host of other sites clearly suggests the usage of the tanks for a long period of time. Sometimes, they were constructed on elevated ground, usually near a watercourse, often covering an area of 2 to 20 ha. Megaliths are generally found south of the habitation mound and were known to the local people as *kurangkupattarai* or *kurangkupaṭṭatai* meaning 'workshop of monkeys'. The urn burials were known as *matamatakkasal* a corrupt form of *mutumakkal tali* meaning old man's burial urn.

The habitation mounds are thin and so are easily missed. The mounds range between 2 and 20 ha in extent. The various habitation-cum-burial sites are located in relation to the tanks. Small hillocks and rocky outcrops were preferentially selected. This could be to avoid dense forests which were not favourable to live in or cultivate. They selected sites where water was easily available or accessible. In Kulattur taluk nearly ninety percent of the Megaliths are located close to tanks. In some places perennial ponds were in use in the absence of tank or rivers.

Raw Material

The Megaliths, with a few exceptions, are within a distance of one or two kilometres from a source of the boulders used in their construction. Round boulders were used in the construction of the circles, and slabs for the construction of cists and capstones. Both dressed and undressed slabs were used to prepare a cist whereas undressed slabs were generally used for capstones. The circle stones are either granite or laterite blocks. Granite is used mostly in the western part of the district, particularly in western part of Kulattur and Tirumayam taluks. The use of laterite blocks both dressed and undressed increases in the eastern part of the district. Quarrying, lifting, transporting and erecting these huge stone slabs and boulders certainly required a developed technology. Traditional methods of removing stone using firing techniques are still being used in the Narttamalai hills. The occurrence of chisel marks on the edge of slabs, orthostats and capstones indicates, in addition to other methods, they used chisels to quarry the raw material for making orthostats.

Table 1: List of Archaeological Sites in Pudukottai District

S. No.	Site	Taluk	Culture	Long.	Lat.	Material Remains
1	Adanur	Tirumayam	Megalithic	78° 45'	10° 11'	Cairn circle with cist and urn burial
2	Alampatti	Tirumayam	Megalithic	78° 36'	10° 22'	Cairn circle with transepted cist
3	Alangudi	Kulattur	Megalithic Historical	78° 49'	10° 38'	Cairn circle entombing cist and Urn Habitation, Black and Red ware (hereafter BRW) Siva temple Loose sculptures of Vishnu, Durga, Ganesha, Parvathi, Jain Tirtankara
4	Alattur	Kulattur	Historical	78° 37'	10° 28'	Siva temple, Jain Tirtankara sculpture
5	Ammacattiram	Kulattur	Megalithic	78° 46'	10° 31'	Cairn circle entombing cist and Urn (50)
6	Ampurapatti	Kulattur	Megalithic	78° 40'	10° 37'	Cairn circle entombing cist and Urn (50)
7	Annavasal	Kulattur	Megalithic	78° 42'	10° 27'	Cairn circle entombing cist and Urn (50)
8	Aranipatti	Kulattur	Megalithic	78° 52'	10° 36'	Cairn circle entombing cist and Urn
9	Arasamalai	Tirumayam	Megalithic	78° 38'	10° 21'	Cairn circle with cist and urn burial
10	Arimalam	Tirumayam	Megalithic	78° 53'	10° 15'	Cairn circle with urn burial, Habitation mound, BRW
11	Ariyur	Kulattur	Megalithic	78° 44'	10° 25'	Cairn circle entombing cist and Urn (50) Sluice inscription
12	Atanappatti	Kulattur	Megalithic	78° 42'	10° 34'	Cairn circle entombing cist and Urn
13	Attur	Tirumayam	Megalithic	78° 39'	10° 16'	Cairn circle with transepted cist
14	Cinnapantarak kudi	Kulattur	Megalithic Historical	78° 47'	10° 39'	Cairn circle, Habitation mound, Sluice inscription, Siva temple
15	Dakshinapuram	Alangudi	Megalithic	78° 55'	10° 20'	Cairn circle with urn burial, Habitation mound
16	Erichchili kulam	Kulattur	Megalithic	78° 36'	10° 30'	Cairn circle entombing cist and urn
17	Kalakkudipatti	Kulattur	Megalithic	78° 54'	10° 38'	Cairn circle entombing cist
18	Kaliyapatti	Kulattur	Megalithic	78° 53'	10° 39'	Cairn circle entombing transepted cist (100), urn burial, BRW, iron sword
19	Kannanur	Tirumayam	Megalithic	78° 41'	10° 15'	Cairn circle with slab circle, menhir
20	Kanniyapatti	Kulattur	Megalithic	78° 48'	10° 31'	Cairn circle entombing cist
21	Kattukottaipatti	Kulattur	Megalithic	78° 54'	10° 18'	Cairn circle, stone circle, Urn burial, BRW
22	Kilaiyur	Kulattur	Megalithic	78° 57'	10° 15'	Cairn circle with transepted cist
23	Kilaiyur	Alangudi	Megalithic	78° 52'	10° 37'	Cairn circle with urn burial, Habitation mound
24	Killanur	Kulattur	Megalithic	78° 54'	10° 33'	Cairn circle, stone circle, urn burial, BRW
25	Killukudi	Kulattur	Historical	78° 36'	10° 27'	Perumal temple, inscription on a slab
26	Kiranur	Kulattur	Megalithic Historical	78° 46'	10° 34'	Cairn circle, cist, urn burial, Siva temple
27	Kodumbalur	Kulattur	Megalithic Historical	78° 30'	10° 32'	Cairn circle with cist burial, Sluice inscription, Jain Tirtankara, Monument
28	Kudalur	Tirumayam	Megalithic	78° 41'	10° 21'	Cairn circle with cist and urn burial, Sluice, BRW
29	Kulamangalam	Tirumayam	Megalithic	78° 42'	10° 19'	Cairn circle with cist and urn burial
30	Kuntantarkoil	Kulattur	Historical	78° 54'	10° 34'	Rock-cut cave
31	Kudumiyanmalai	Kulattur	Megalithic Historical	78° 39'	10° 25'	Rock painting, Tamil-Brahmi inscription, Rock-cut cave, Jain bed, Siva Temple, Music inscription
32	Lempalakkudi	Tirumayam	Megalithic	78° 45'	10° 18'	Cairn circle
33	Malaiyadipatti	Kulattur	Historical	78° 37'	10° 16'	Rock-cut cave
34	Malaiyadipatti	Tirumayam	Megalithic	78° 54'	10° 39'	Cairn circle with cist and urn burial
35	Malaiyakkoil	Tirumayam	Historical	78° 43'	10° 19'	Rock-cut cave temple, Jain Tirtankara

S. No.	Site	Taluk	Culture	Long.	Lat.	Material Remains
36	Mankatevanpatti	Kulattur	Megalithic	78° 49'	10° 34'	Cairn circle with cist and urn burial (500), Habitation mound, BRW
37	Maravamaturai	Tirumayam	Megalithic	78° 33'	10° 22'	Cairn circle with transepted cist and urn burial
38	Marayanpatti	Kulattur	Megalithic	78° 44'	10° 24'	Cairn circle with transepted cist
39	Marudur	Kulattur	Historical	78° 49'	10° 34'	Jain Tirtankara, Aiyyanar
40	Marutampatti	Kulattur	Megalithic	78° 41'	10° 34'	Cairn circle with transepted cist and urn, Sluice inscription
41	Matarapatti	Kulattur	Historical	78° 31'	10° 31'	Tank with inscription
42	Matiyanallur	Kulattur	Megalithic	78° 45'	10° 26'	Cairn circle with cist, BRW, iron sword
43	Mayilappatti	Kulattur	Megalithic	78° 43'	10° 24'	Cairn circle, Jain Tirtankara
44	Melanilai malam patti	Tirumayam	Megalithic	78° 36'	10° 17'	Cairn circle with cist and urn burial
45	Melappanaiyur	Tirumayam	Megalithic	78° 46'	10° 18'	Cairn circle with cist and urn burial, Habitation mound, Sluice inscription
46	Melataniyam	Tirumayam	Megalithic	78° 34'	10° 25'	Cairn circle with urn burial, Habitation mound, BRW
47	Menampatti	Tirumayam	Megalithic	78° 40'	10° 16'	Cairn circle with urn burial, Habitation mound, BRW
48	Mettuppatti	Kulattur	Megalithic	78° 42'	10° 35'	Cairn circle with stone slab (menhir)
49	Meyyanapatti	Kulattur	Historical	78° 36'	10° 31'	Habitation mound, RW, grooved tiles
50	Minnattur	Kulattur	Megalithic	78° 57'	10° 35'	Cairn circle with cist and urn burial (500), BRW, Habitation mound
51	Minnaveli	Kulattur	Historical	78° 31	10° 30'	Siva temple, Sluice inscription
52	Mosakkudi	Kulattur	Megalithic Historical	78° 49'	10° 33'	Cairn circle, Urn burial, Sluice inscription, Jain Tirtankara, Jain Centre
53	Mulangkudi	Tirumayam	Megalithic	78° 34'	10° 18'	Cairn circle
54	Muttampatti	Kulattur	Megalithic	78° 51'	10° 30'	Cairn circle with cist, urn burial
55	Muttukadu	Kulattur	Megalithic	78° 48'	10° 29'	Cairn circle, urn burial
56	Nallur	Tirumayam	Megalithic	78° 48'	10° 22'	Cairn circle with cist and urn burial
57	Nangupatti	Kulattur	Historical	78° 48'	10° 33'	Siva temple, Herostone
58	Nanjur	Kulattur	Megalithic	78° 48'	10° 34'	Cairn circle, urn burial, Siva temple, Loose sculptures of Durga, Vishnu, Chandrasekara, Jain Tirtankara
59	Narttamalai	Kulattur	Historical	78° 45'	10° 30'	Rock-cut cave temple, Early Chola temple, Trade guild inscription, Sluice inscription, Jain centre
60	Nerukipatti	Tirumayam	Megalithic	78° 43'	10° 21'	Cairn circle with urn burial, Habitation mound, BRW
61	Nerunjikudi	Kulattur	Megalithic	78° 38'	10° 22'	Cairn circle entombing transepted cist
62	Notiyur	Kulattur	Historical	78° 57'	10° 39'	Habitation mound. RW, BW, tiles, terracotta beads, iron slag, Siva temple
63	Oliyamangalam	Tirumayam	Megalithic	78° 25'	10° 25'	Cairn circle with cist burial, Urn burial, Siva temple, Sluice inscription, Habitation mound, BRW
64	Otukkur	Kulattur	Historical	78° 45'	10° 33'	Habitation mound, RW, Sluice inscription
65	Otuvanpatti	Kulattur	Megalithic	78° 51'	10° 35'	Cairn circle with cist and urn burial
66	Pacippatti	Kulattur	Historical	78° 42'	10° 33'	Sluice inscription
67	Pakkudi	Kulattur	Historical	78° 39'	10° 34'	Habitation mound, BRW
68	Paraipatti	Kulattur	Historical	78° 47'	10° 34'	Siva temple, Habitation mound
69	Parali	Tirumayam	Megalithic	78° 43'	10° 12'	Cairn circle with transepted cist, urn burial, Habitation mound, BRW

S. No.	Site	Taluk	Culture	Long.	Lat.	Material Remains
70	Parampur	Kulattur	Megalithic	78° 38'	10° 26'	Cairn circle with cist and urn burial
71	Perungalur	Pudukottai	Megalithic Historical	78° 55'	10° 29'	Cairn circle, Stone circle, Siva temple, Furnace, iron slag
72	Peyalvalayapatti	Kulattur	Megalithic	78° 35'	10° 29'	Sluice inscription
73	Ponpetti	Avudaiyar koil	Megalithic Historical	78° 63'	10° 43'	Cairn circle, Siva temple, Perumal temple, Habitation mound, Sluice inscription
74	Poyyamani	Kulattur	Megalithic	78° 28'	10° 33'	Cairn circle with cist and urn burial
75	Pulivalam	Tirumayam	Megalithic	78° 46'	10° 16'	Cairn circle
76	Pulvayal	Kulattur	Megalithic	78° 52'	10° 22'	Cairn circle with cist and urn burial. Urn burial yielded skeleton remains, Habitation mound, BRW
77	Putakkudi	Kulattur	Megalithic	78° 34'	10° 39'	Cairn circle with transepted cist
78	Puttambur	Kulattur	Megalithic	78° 51'	10° 28'	Cairn circle, Jain centre, Jain Tirtankara, Siva temple
79	Putuvayal	Kulattur	Megalithic	78° 49'	10° 30'	Cairn circle, cist, urn, Habitation mound, BRW
80	Rapusal	Kulattur	Megalithic	78° 41'	10° 31'	Cairn circle, Habitation mound, Siva temple, sluice inscription
81	Rasalipatti	Kulattur	Historical	78° 28'	10° 36'	Hero stone, Sluice inscription
82	Sappanipatti	Kulattur	Megalithic	78° 49'	10° 37'	Cairn circle entombing cist and Urn
83	Sadaiyamangalam	Avudaiyar koil	Megalithic	78° 62'	10° 43'	Urn burial
84	Satyamangalam	Kulattur	Megalithic Historical	78° 46'	10° 28'	Cairn circle entombing transepted cist Habitation mound Sluice inscription
85	Sempattur	Kulattur	Historical	78° 50'	10° 29'	Jain Tirtankara sculpture Sluice inscription
86	Senaiyakudi	Kulattur	Historical	78° 51'	10° 31'	Habitation mound, Red ware (hereafter RW), Terracotta beads, Grooved tiles, bricks, glass beads, copper coin, Jain Tirtankara, Three sluice inscription
87	Sengalur	Kulattur	Megalithic	78° 53'	10° 40'	Cairn circle entombing cist, Urn burial, Habitation mound BRW
88	Setampatti	Tirumayam	Megalithic	78° 40'	10° 13'	Cairn circle with cist burial, Urn burial
89	Sevarappatti	Tirumayam	Megalithic	78° 31'	10° 25'	Cairn circle
90	Singatta kurichchi	Kulattur	Megalithic	78° 41'	10° 40'	Cairn circle entombing cist and urn, Habitation mound, BRW
91	Sittannavasal	Kulattur	Megalithic	78° 47'	10° 28'	Cairn circle with cist and urn, Tamil-brahmi inscription, Inscription in a transitional stage from Tamil-Brahmi to *vatteluttu,* Jain bed, rock-cut cave, paintings
92	Sivapuram	Tirumayam	Megalithic	78° 47'	10° 21'	Cairn circle with transepted cist, Urn burial
93	Sokkanathan patti	Tirumayam	Megalithic	78° 32'	10° 21'	Cairn circle with urn burial
94	Sulakampatti	Kulattur	Megalithic	78° 57'	10° 39'	Urn burial, BRW, iron swords
95	Sundaram	Tirumayam	Megalithic	78° 37'	10° 18'	Cairn circle with urn burial
96	Tachchampatti	Kulattur	Megalithic	78° 35'	10° 36'	Cairn circle with cist
97	Tayinipatti	Kulattur	Megalithic	78° 45'	10° 55'	Cairn circle, transepted cist, urn burial, Sluice inscription
98	Temmavur	Kulattur	Historical	78° 55'	10° 36'	Sluice inscription
99	Tennampatti	Kulattur	Historical	78° 33'	10° 33'	Sluice inscription
100	Tennilai	Tirumayam	Megalithic	78° 34'	10° 19'	Cairn circle

S. No.	Site	Taluk	Culture	Long.	Lat.	Material Remains
101	Tirukkattalai	Alangudi	Megalithic Historical	78° 51'	10° 22'	Cairn circle with urn burial, Siva temple, iron slag, Habitation mound
102	Tirumayam	Tirumayam	Megalithic	78° 45'	10° 14'	Urn burial, Habitation mound, Rock-cut cave temple, Fort, Rock painting, Sluice inscription
103	Tiruppur	Kulattur	Megalithic	78° 51'	10° 33'	Cairn circle with cist and urn burial, Siva temple, Jain Tirtankara
104	Tiruvappur	Pudukottai	Megalithic	78° 48'	10° 22'	Cairn circle, Urn burial, Jain centre, Jain Tirtankara, merchant guild inscription, Sluice inscription
105	Tudaiyur	Kulattur	Megalithic Historical	78° 49'	10° 30'	Cairn circle with cist and urn burial, BRW, iron sword, Siva temple
106	Tuttur	Tirumayam	Megalithic	78° 33'	10° 18'	Cairn circle, urn burial, BRW, bowls, plates, ring stands
107	Uchchani	Kulattur	Megalithic	78° 51'	10° 27'	Cairn circle with cist burial, Habitation mound, BRW
108	Uppiliyakkudi	Kulattur	Historical	78° 48'	10° 32'	Habitation mound, Aiyyanar, Sluice inscription
109	Vaittur	Kulattur	Megalithic	78° 52'	10° 28'	Cairn circle with cist and urn burial
110	Valakkuruchchi	Tirumayam	Megalithic	78° 39'	10° 20'	Cairn circle with cist and urn burial, Sluice inscription
111	Valiyampatti	Kulattur	Megalithic	78° 51'	10° 36'	Cairn circle with cist and urn burial
112	Vallatirakottai	Alangudi	Megalithic	78° 53'	10° 19'	Urn burial, furnace, iron slag
113	Vantakkottai	Alangudi	Megalithic	78° 52'	10° 19'	Urn burial, iron slag
114	Varappur	Pudukottai	Megalithic	78° 58'	10° 28'	Cairn circle
115	Vattanak kurichchi	Kulattur	Megalithic	78° 50'	10° 30'	Cairn circle with cist and urn burial. Circle having slab circle, Habitation mound, BRW, Jain centre
116	Vayalokam	Kulattur	Megalithic	78° 42'	10° 24'	Stone circle, cairn circle, Sluice inscription, Siva temple
117	Vellanur	Kulattur	Megalithic	78° 48'	10° 27'	Cairn circle with cist burial, Jain Tirtankara, Sluice inscription
118	Veppalampatti	Kulattur	Megalithic	78° 40'	10° 34'	Cairn circle with cist burial
119	Vilappatti	Kulattur	Megalithic	78° 42'	10° 34'	Cairn circle with cist and urn, Habitation mound, BRW., iron sword, ring stand
120	Virachchilai	Tirumayam	Megalithic	78° 42'	10° 17'	Cairn circle with cist
121	Viranampatti	Tirumayam	Megalithic	78° 40'	10° 17'	Urn burial
122	Virutappatti	Kulattur	Megalithic	78° 29'	10° 35'	Cairn circle with cist and urn (1000), Habitation mound, Jain Tirtankara
123	Visalur	Kulattur	Megalithic	78° 40'	10° 24'	Cairn circle, stone circle, Habitation mound, Sluice inscription
124	Visalur	Tirumayam	Megalithic	78° 51'	10°38'	Cairn circle, stone circle, urn burial, Sluice inscription
125	Vittampatti	Kulattur	Megalithic	78° 37'	10° 39'	Cairn circle with cist and urn

Table 2: Sluice inscriptions in Pudukkottai District

S.No	Village	Taluk	King	Year	Reference
1	Aramalai	Kulattur	—	1547	Rajendran (1997:24)
2	Arasamalai	Tirumayam	Rajendra I	1019	Rajendran (1989) (unpublished)
3	Ariyur	Kulattur	Uttamacholan	984	Rajendran (1989) (unpublished)
4	Ariyur	Kulattur	Kulothunga I	1117	Shanmugam (2001: 29-43)
5	Chettimuttipatti	Kulattur	—	9th cent.	Rajendran (1991: 39)
6	Chinnapandrak kudi	Kulattur	ViraPandyan II	1340	Author discovered
7	Chitthupatti	Kulattur	—	9th cent.	Rajendran (1993: 14)
8	Idaiyattur	Tirumayam	—	10th cent.	Rajendran (1991: 39)
9	Irappusal	Kulattur	—		Author discovered
10	Kannanur	Tirumayam	Koccadaiya maran	9th cent.	Rajendran (1991: 38)
11	Kavinadu	Putukkottai	Komaran Sadaiyan	8th cent.	Rajendran (1993: 12)
12	Kavinadu	Putukkottai	Kulotunga II	1147	Rajendran (1989) (Unpublished)
13	Kodumabalur	Kulattur	Innurruvar	10th cent.	Rajendran (1991: 40)
14	Konnaiyur	Kulattur	Kulottunga III	13th cent.	Author discovered
15	Kottiyur	Kulattur	Kulotunga I	1117	Rajendran (1989) (Unpublished)
16	Marutampatti	Kulattur	—	12th cent.	Author discovered
17	Matiyanallur	Kulattur	—	—	Rajendran (1993:12)
18	Melappanaivur	Tirumayam	Sri Arangan Periyan	11th cent.	Shanmugam (2001:29-43)
19	Melappanaiyur	Tirumayam	—	13th cent.	Rajendran (1989) (Unpublished)
20	Neyveli	Tirumayam	Nakkan orri	13th cent.	Rajendran (1989) (Unpublished)
21	Narttamalai	Kulattur	Venrimatat Tamilati Araiyan	10th cent.	IPS Ins.no.11
22	Oliyamangalam	Tirumayam	—	12th cent.	Author discovered
23	Otukkur	Kulattur	—	12th cent.	Rajendran (1993: 13)
24	Pacippatti	Kulattur	—	15th cent.	Author discovered
25	Perunjinai	Kulattur	—	10th cent.	Rajendran (1993: 13)
26	Perunkudipatti	Kulattur	—	10th cent.	Rajendran (1993:13)
27	Peyal	Kulattur	Kulotunga I	1077	Rajendran (1989) (Unpublished)
28	Ponpetthi	Avudaiyar koil	—	1217	Author discovered
29	Rajagiri	Kulattur	—	12th cent.	Rajendran (1993: 15)
30	Rasalipatti	Kulattur	Nandivarman II	8th cent.	IPS Ins.no.16
31	Rasipuram	Kulattur.	—	13th cent.	Rajendran (1991: 40)
32	Rattinakkudi	—	—	1797	Virasamy (1991: 14)
33	Saththiya mangalam	Kulattur	—	11th cent.	Rajendran (1993: 14)
34	Sempattur	Kulattur	—	13th cent.	Author discovered
35	Senaiyakkudi	Kulattur	—	10th cent.	Rajendran (1993: 14)
36	Seranur	Kulattur	—	—	Rajendran (1993: 15)
37	Sevvalur	Tirumayam	—	15th cent.	Rajendran (1997: 25)
38	Tenmapatti	Kulattur	—	17th cent.	Author discovered
39	Thalinji	Kulattur	—		Author discovered
40	Thayinippatti	Kulattur	—	11th cent.	Author discovered
41	Thuruvasapuram	Tirumayam	—		Author discovered
42	Tirumayyam	Tirumayam	—	—	Rajendran (1993: 12)
43	Uppilikudi	Kulattur	—	11th cent.	Rajendran (1991: 40)
44	Vadaseripatti	Kulattur	—	11th cent.	Rajendran (1993: 13)
45	Valaikkuricchi	Tirumayam	—	12th cent.	Rajendran (1993: 16)
46	Valaikkuricchi	Tirumayam	—	14th cent.	Rajendran (1993: 16)
47	Valamangalam	Kulattur	—	——	Rajendran (1993: 15)
48	Vayalokam	Kulattur	—	10th cent.	Rajendran (1997: 23-24)
49	Vayalokam	Kulattur	—	13th cent.	Rajendran (1997: 24)
50	Vilangurichchi	—	—	19th cent.	Ravi (2001: 86)
51	Viralur	Kulattur	—	10th cent.	Rajendran (1993: 15)
52	Visalur	Kulattur	—	10th cent.	Rajendran (1991: 39)

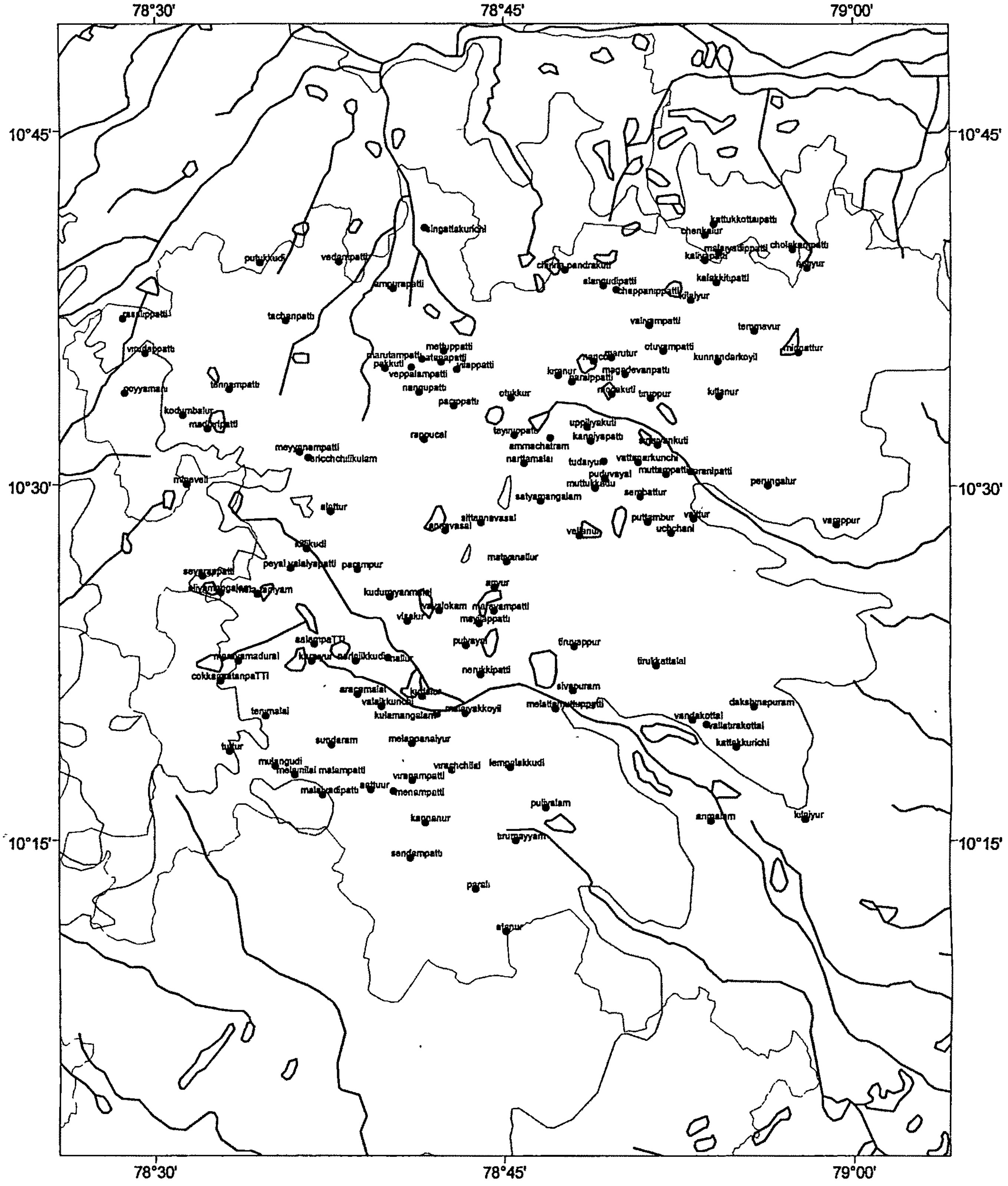


Fig. 1: Archaeological Sites in Pudukottai Region

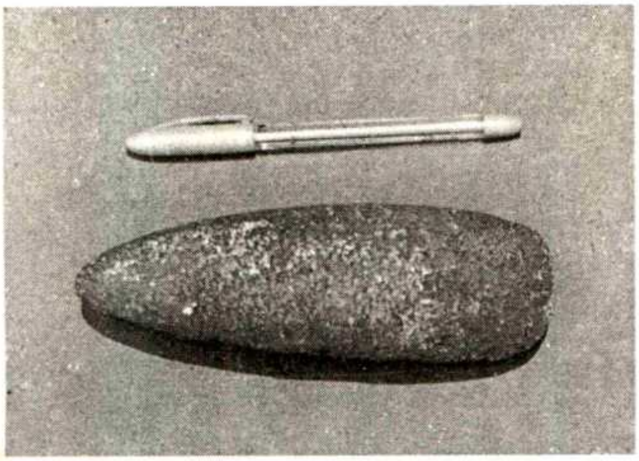


Fig. 2: Melappanaiyur: Neolithic celt

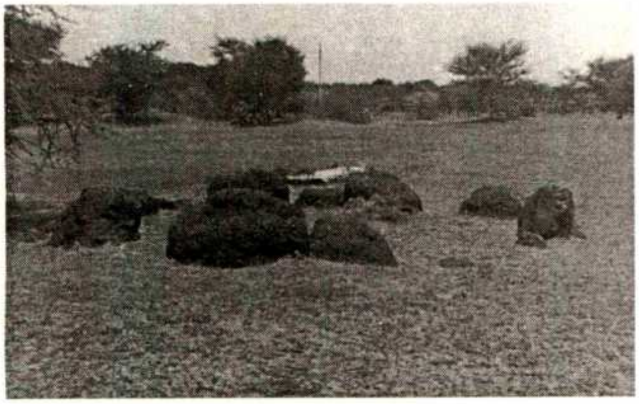


Fig. 3: Vayalokam: Stone circle found in the water spread area of the tank

Distribution Pattern

The region has yielded a large number of sites covering areas of 2 to 20 ha and containing hundreds of burials. The burial complexes comprise a mixture of both small and large circles. No consistent pattern in the layout of the graves has been followed. Large, unusual circles were noticed without any consistent position within the complex. When a site has more than one type of burial, each type occupies a separate portion within the complex. This was observed at Sengalur in Kulattur taluk. It seems that the earliest Megaliths occupied the most elevated part of the site. The pattern of distribution that seems to emerge from the survey was that for each locality there was somewhat connected cluster of sites within a 5 km radius.

The following discussion of Megalithic culture is based on the observations made by different scholars like Venkatarangam Raju (Ayyar 2002a: 522), Iyengar (1976: 476), Srinivasan (1946: 9-16), Ramachandran (1979: 39-42) and the present author. These observations were made in the course of their excavations and explorations carried out in this part of the country. In 1917, K.Venkatarangam Raju (Ayyar 2002a: 522) excavated an urn burial at Nilayapatti near Tirukkattalai in Pulvayal forest, Mottamalai and Aranipatti. In 1919, K.Venkatarangam Raju, P.T.Srinivasa Iyengar and K.R. Venkatarama Ayyar (Ayyar 2002a: 522) excavated an urn burial site at Sadaiyapparai. K.Venkatarangam Raju (Ayyar 2002a: 523) excavated more than 60 cist burials in 1934-35 at Sittannavasal, Aranipatti, Kurantampatti, Thachchanpatti and Tudaiyur and in 1938 at Muttukadu, Kaliyapatti, Kalakkudipatti and Tiruppur (Ayyar 2002a: 523). Ramachandran (1979: 39-42) again opened four megaliths at Sittannavasal in 1975-76. The method of construction of the various burial types can be reconstructed from this excavated data. An attempt is made to place the findings of these investigations in a broader spectrum here.

Types of Burial

The burials were heterogeneous in nature. They contain cairn circle, stone circle, circle with a menhir or standing monolithic slab at the periphery of the circle enclosing varieties of cists and urn burials.

Cairn circle

Cairn circles were constructed from round boulders with a cairn (heap of boulders) at the centre (Fig. 4). Their height above the ground depended upon the nature of the burial and the land. If the soil was soft, the cist or urn was placed 30 to 60 cm below the ground level and then the pit was covered and entombed within a cairn. In this case, the cairn was not raised more than 50 cm. On the other hand if working surface was hard such as in the rocky areas, they dig deeply. They made a small dig to get an adequate depth in which the cist could stand and thereafter it was covered with a cairn and encircled by stone boulders. The small amount of digging was insufficient to completely bury the cist. Since the cist projected out to a certain height, the

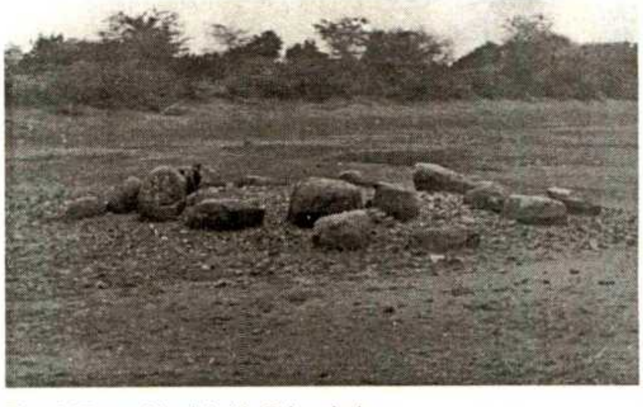


Fig. 4: Vattanakkurichchi: Cairn circle

cairn was also raised one or two metres above the ground level. The diameter or the size of the cairn circle also depended upon the nature of the burial embedded in it. Transepted cists are associated with cairn circles of unusually large diameters. The diameter of the circles varies from 5 to 10 metres.

A wall or slab or sometimes both encircled these cairn circles. The wall is built of triangular stones placed side by side in three to four courses. The base (broader face) of the triangular stone or slab is slightly curved and this curved portion was placed facing outer side. The pointed portion of the slab was placed facing the inner side. Sometimes the wall's inner face is found lined with rectangular stones or coarse gravel. This type of construction occurs at Tutaiyur. In few cases, the inner face and outer face of the wall was built of rectangular stones and the gap between the inner and outer face of the wall filled with small stones.

Stone circle

A few sites yielded stone circles made of round boulders. These circles, having an average diameter of 8 m are devoid of any cairn packing. Most of the urns unearthed in this region come from such stone circles. In cairn circles, stone boulders were generally placed one after another without any gap to form a circle but in stone circles some gap between two boulders is present, serving merely to demarcate the grave. They are found all over the region with a concentration in the eastern parts of the taluks of Kulattur, Tirumayam and Pudukottai and Alagkudi taluks. Some of the graves have double circles as at Tutaiyur and Cinnapantarakkudi. In case of double circles, the inner and outer circles are built of boulders.

Graves with slab circles

Apart from the usual types of Megaliths some unusual types are also found in this region. The sites at Tudaiyur (Fig. 5), Vattanakurichchi (Fig. 6), Kannanur (Fig. 7) and Sittannavasal yielded a circle with a standing monolithic slab at the periphery of the circle. The slabs are found either in single or doubles erected at any part of the circle. At present, only one or two monolithic slabs are found but close observation made at the above sites led to the belief that earlier there were more slabs. According to the local people, a few slabs were broken.

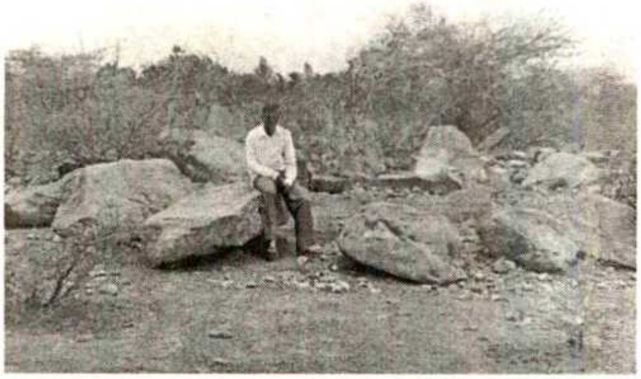


Fig. 5: Tudaiyur: Slab circle encircling a cist burial

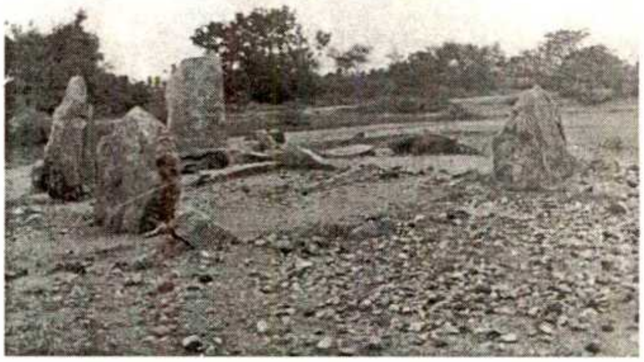


Fig. 6: Vattanakurichchi : Slab circle encircling a cist burial

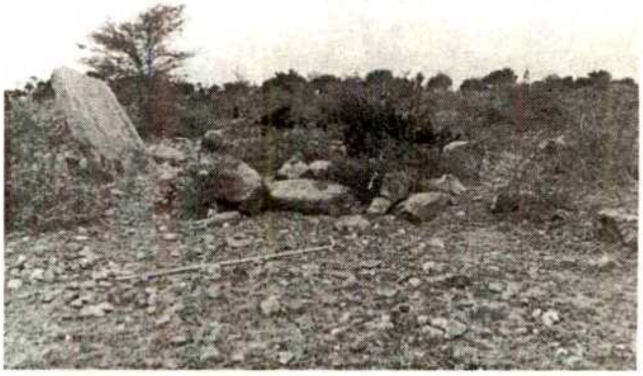


Fig. 7: Kannanur : Slab circle encircling a cist burial

Cist burial

A major type of burial encountered within the region is the cist burial. They are invariably found in a cairn circle. It has three sub-types: (1) simple cist burial constructed of four orthostats; (2) transepted cist with single, double and multiple chambers; and (3) cist with passage.

Simple cist

This type of cist is a box-like structure constructed of four orthostats or upright stone slabs kept in clockwise or anti-clockwise direction on a floor slab and enclosed by a capstone. A round porthole is found at the centre of the eastern orthostat.

Cist with passage

Besides the cist in some cases a passage was constructed in front of the porthole by placing three vertical slabs. Two slabs were placed on either side of the porthole at right angles to the eastern orthostat and the third slab was placed against these two slabs. In most cases the slabs used to construct the passage were not raised from the bottom of the pit. The pit was filled with boulders or sand up to the level of the bottom of the porthole and a base slab placed in the passage. Then the vertical passage slabs were placed as stated above. Generally the passage of the simple cist is smaller in size.

In case of transepted cist, the passage is generally found against the chamber that had a porthole. The burials so far opened suggest that usually the southern chamber had a porthole. The pothole that is found on the transepted cist serves as a connecting link between the chambers. If both chambers had a porthole then the passage covers both the portholes. The closing slab of the passage always ends with the enclosing circle.

Transepted cist

The simple cist bifurcated longitudinally resulting in two or more chambers are called transepted cist. A general pattern is followed in the construction of a transepted cist in this region. The cist was constructed of thick orthostats around a floor slab and had a capstone. The cist has six orthostats besides the capstone, floor slab and central bifurcation slab. The eastern and western sides have two orthostats each and the northern and southern sides each have one. The length of each orthostat on the southern and northern side varies from 2.50 to 3.00 m. So the total length and breadth of the cist for the 2.50 m orthostat comes to 5.00 x 1.50 x 2.00 m. This is rectangular in shape. A central slab bifurcated the cist into two halves. This central transepting slab is generally lower in height than the outer orthostats. The cist is covered usually by a single capstone and in rare occasions more than one slab. The slabs are undressed and have an average thickness of 30 cm.

Two round portholes are observed, one on the eastern orthostat and another on the central transepting slab with average diameter of the 50 cm. The first chamber contains the grave goods. The pottery consists mainly of bowls, dishes and miniature pots of black and red ware, four legged jars of red ware and ring stands of black polished ware. The second chamber yielded only skeletal remains.

In lengthwise division of the transepted cist also had two types. In the first type the cist is divided into two halves by inserting a transepted slab at the centre. In the second type, one of the chambers of the transepted cist is further divided into two halves making the total number of chambers into three. Sometimes, as one noticed at Tutaiyur and Sittannavasal, one of these chambers is further divided breadth wise to raise the total number of chambers to four. A porthole either directly from the passage or through transepting slabs usually connected all the chambers. Generally a single capstone is surmounted on the cist leaving the passage open. In the case of transepted cists placement of orthostats hardly followed any clockwise or anti-clock wise direction. This method of construction is not required in transepted cist varieties as the central transepting slab prevents any inward collapse of the cist. In the case of simple cist the inward collapse of the cist can be averted by placing them in *swastika* pattern. This clearly suggests that the method of construction had only functional value rather than any spiritual value.

Cist with benches

The cist containing benches were noticed at Sittannavasal and Tudaiyur. At Sittannavasal, the transepted cist was met with a flat slab, which lay up to half the height of the orthostatic slab along the whole length of the cist to serve as a bench. The stone bench occupied half the space of the chamber, the other half being vacant. In few cases, the northern half of the chamber was divided into an upper and a lower cell by a horizontal slab, supported on two upright side slabs at the ends. The two portholes one above the other is made on the transept slab which made access to the lower and upper cells easy.

Porthole

Usually the porthole was noticed on the eastern slab. In case of transepted cist it was found on the eastern slab and on the bifurcating or transepting slab. Occasionally, the porthole in the simple cist or the first porthole in the case of cists with multiple portholes was covered on the outer side with a rectangular slab. This phenomenon is noticed in the sites like at Sittannavasal, Tudaiyur, Thayinipatti, Sengalur, and other places. The shape of the porthole is round.

Method of Offering

Grave goods are confined to chambers and, in case of urn burials; the grave goods were usually placed inside the urn. In a simple cist the grave goods and skeletal remains are placed on the floor slab. Grave goods are generally found near the head. In case of transepted cist, skeletal remains are found in the northern chamber and grave goods in the southern chamber. Some examples of urns placed inside cists were found at Sittannavasal (Gandhi 1983: 869-878). The offerings were made against the porthole. Swords are generally found. Other grave goods like four legged jars, ring stands, bowls, conical vessels, small bowls and plates are also found. The skeletal remains were placed in east-west orientation with head on the east. All are secondary burials placed in an articulated or in disarticulated form.

Some of the cists yielded only few bones or were devoid of any skeletal remains.

Urn Burials

Urn burials occur throughout this region with a concentration in the eastern and southeastern parts. The urns are uniform in shape with wide mouths, bulbous or globular bodies and truncated stem bases. The rims are rolled and heavy. They are an ill fired coarse red ware. It seems that the stem was luted to the body of the urn. The urns were either covered with a capstone (Fig. 8) or a deep shallow bowl and in quite a few cases they were without any capstone. The urn was placed vertically, or horizontally or in a slanting position. The mouth always faced north. The pit the urn was placed in was either shallow or trough shaped. Trough shaped pits were used for urns placed in a horizontal position. Normally the urn was buried 30 to 90 cm below the ground level and then covered with an inverted bowl or a capstone and encircled by boulders. In most places urns did not have any Megalithic features. Skeletal remains are found inside the urn and a number of small pots were kept around this urn at the bottom of the pit. From excavation reports, it is presumed that the dead were placed in sitting posture. Personal ornaments of the deceased such as bracelets made of bronze or chank-shells, nose rings and beads made of carnelian and glass were placed along with the dead. Besides, small pots like bowls, plates of various sizes and shapes were placed inside the urn. Bronze vessels, iron tools like swords, daggers, spearheads and arrowheads with spiked and hollow handles were placed. The urns were filled with sand and were covered with a lid. The urn that found at Pulvayal had a complete skeleton placed in a seated posture with short sword in the right hand, while the left hand rested on the thigh (Ayyar 2002a: 523).

Local Name

The Megaliths are referred to by a number of different terms in different parts of the region. The cists are called *kurangupattarai* and *kurangupattatai* (meaning monkey's workshop). The urns are known as *matamatakkasal* or *matamatakkacati* a corrupt form of *mutumakkattali* or *mutumakkatcati*.

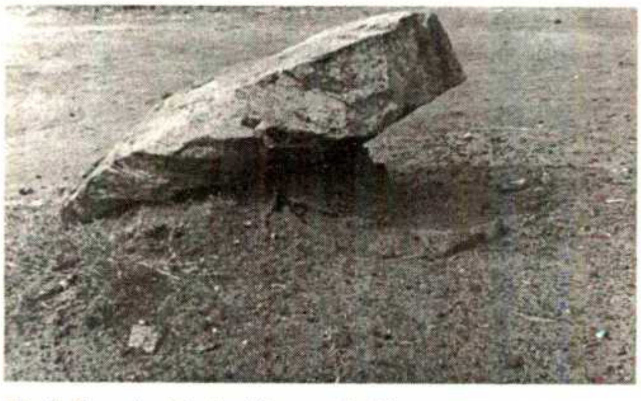


Fig. 8: Sengalur: Urn burial covered with a capstone

Industry

The occurrence of iron slag, furnace material and tuyeres at sites like Perungalur and Vallatirakottai shows the development of a metallurgical technology. Iron slag at the above sites is sometimes found in huge heaps. Magnetic iron ore was used extensively for iron smelting. The preliminary study of the furnace found at Perungalur suggests that the iron smelting furnace was in vogue (Sasisekaran and Raghunatha Rao 1999: 263-272). Such iron smelting places were identified in the 50 km stretch between Kandarvakottai in the north and Vallatirakottai in the south. Interestingly, an inscription engraved in 1232 A.D. during the fourth regnal year of Vira Pandya (1228-1272 A.D.) speaks of a cess of 1200 *kasu* a year being collected for the right to mine iron ore, and two blacksmiths of this place being required to pay 6 *kacu* a year for maintaining two lamps in the temple at the place (*Inscriptions of Pudukottai State* 427).

The present study shows the occurrence of two different types of Megaliths. The first type, cairn circles with cist burials, probably entered this region from the west, most probably from the Kongu region. This variety is mainly concentrated in the hilly areas. Stone circles without any cairn packing can be considered a degenerate form of the cairn circles. The second type of Megaliths is urn burials found without any Megalithic construction and occurs predominantly in the eastern part of the region and appears to be an indigenous type. These two main types, cist and urn burials, were superimposed in the area of contact. When the people using cists came into contact with the people using urns, both systems got assimilated. This is indicated by the urns found inside cists at Sittannavasal. Quite interestingly, a circle at Sengalur yielded both cist and urn burials placed separately within a circle.

Early Historic times

The continuity of Megalithic culture into Early Historic period is seen in references in the literature and inscriptions. Graphic references are found in Sangam literature *Purananuru* and *Akananuru* to Ollaiyur. Kodumpai (present Kodumbalur) is referred to in the epic *Silappathikaram*. Tamil-Brahmi inscriptions have been discovered at Sittannavasal and Kudumiyanmalai.

The Sangam poet Kutavayir Kirattanar sang a poem on the death of Ollaiyurkilan makan Perunjsattan (Perunjsattan, son of the kilan-chief of Ollaiyur), who hails from Ollaiyur of Ollaiyurnadu (*Purananuru*: 242). The Ollaiyur is identified with modern Oliyamangalam.

Megalithic cairn circles made of huge laterite blocks are found on the *ulvayil* of the irrigation tank lying on the northern side of the village and on the either side of the road leading to Sevarappatti. It is so unfortunate that most of the laterite blocks are being removed for construction. Even the cairns placed as heap at the centre of the circle are also removed for construction. According to the elders of the village, earlier there were more than thousand burials but today there are only a few burials. However, the remnants of the burials like capstones are visible on the ground. Some of the urn burials are exposed on the removal of the capstone. These were placed vertically in a pit. Another set of Megalithic cairn circles are found a km west of Oliyamangalam, east of Sevarappatti and south of Vayirappatti. Both dressed and undressed laterite blocks locally called *curukkiyankal* were used. More than 100 burials are found in which nearly 10 are intact. Remaining burials are being disturbed. There are two habitation mounds. The first one called *nattam* is located on the southern side of the Siva temple. It yielded grooved tiles, red ware, terracotta beads and glass bangles, all belonging to the historical period. Another habitation mound called *nattamedu* is located on western side of the village Kayampatti that lies a km north of the Siva temple and on the northern end of the irrigation tank. It yielded black and red ware and bone tools. Villagers told that there is a hero stone in the field located northern side of the village deity Pallakkaruppar koil. This temple, a *palalayam*, lies a km east of the Kayampatti village. The irrigation tank occupies the northern side of the village and yielded a sluice with an inscription engraved on the exterior surface of the southern slab during the 4th regnal year of the Virachola. This village is clearly mentioned as Ollaiyur. *Akananuru* refers this place as the capital of Pandyar (*Akananuru* 25, 279). One of the Pandyar chiefs Ollaiyurtanta Putha Pandyan (Putha Pandyan who gave Ollaiyur), was an author of one verse in *Akananuru* and three verses in *Purananuru*. His queen, who committed *sati* on his death, also wrote poetry (*Purananuru* 246, 247). Inscriptions datable to 4-5th century A.D. were recently discovered at Pulangkurichi. They refer to the territorial division Ollaiyurkurram (Subbarayalu 1991: 57-69). It is evident that the area in and around the main village Ollaiyur had developed into a separate territorial unit. This suggests, further, that the main village Ollaiyur might date even before 4th century A.D.

Another important site, Sittannavasal, near Annavasal, lies 17 km northwest of Pudukottai on the Pudukottai-Iluppur road. Sittannavasal is corrupt form of Sittannavayil, which means 'the abode of great saints'. The earliest inscription, found in this district is engraved on a Jain rock, bed in Tamil-Brahmi script and is datable to 3rd century B.C. Nearly 17 stone beds, with a stone pillows made in a natural cavern on the eastern side of the hillock popularly known as *Elatipattam* have been found. The inscription records that the Ilayar of Sirupavil made the bed for Kavuti Itan born at Kumulur in Eruminadu. Recently an inscription datable to 5th century A.D in the transitional stage from Tamil-Brahmi to *Vatteluttu* script was found engraved on the rocky surface at this site. This inscription with pulli (dot) is palaeographically identical to the one that found at Pulangkurichi (Rajavelu 1995: 9-12).

The famous rock-cut cave temple excavated by Pandya king is on the western slope of the central rock. An inscription of the Pandya king Varakunan Sivallapan is found on the southern wall of the temple. Ilangkautaman of Madurai constructed the front *mandapam*. This place is also known for the world famous fresco paintings. More than 50 Megalithic stone circles are found scattered in the barren land. The circles are mostly built of granite slabs and occasionally with laterite blocks called *curukkankkal* whereas the east facing transepted cist is built of granite slabs. The cist had a passage on its eastern side. The passage is enclosed with slab, which sometimes projected above the ground. The eastern slab of the chamber had a round porthole. The disturbed burial yielded a black and red ware bowl, a small iron sword and black polished ring stand. One of the circles had an urn covered with an oval shaped slab. Interestingly among the circles few (about three) had a slab circle. The slab circle is built of huge stone blocks planted vertically around the cist. Such types are also noticed at Tudaiyur and Vattanakurichi. The special treatment meted out to these two or three circles shows their importance. These Megaliths were locally known as *kurangupattarai*. The laterite blocks placed, as a part of a circle are sometimes well dressed. This was excavated in 1934-35 by K.Venkatarangam Raju (Ayyar 2002a: 523; Ayyar 2002b: 1110). Again Ramachandran (1975-76: 39-42) excavated it in the year 1975-76. In total, they opened three Megaliths. It yielded a cairn circle entombing a cist burial having a passage on the east with round porthole. Some times the cist is divided into two chambers there by making a transepted cist. The urns were placed inside the cist. The urns contain Black-and-Red ware bowls and plates.

Kodumbalur is on the Pudukottai-Manapparai road at the distance of 40 km northwest of Pudukottai. This is one of the ancient places mentioned in *Silappathikaram* as town lying on the highway between Uraiyur and Madurai, respectively the Chola and Pandya capitals of the *Sangam* age. The ancient names are *Kodumpai* and *Irukkuvelur*. It was the seat of *velir* called Irukkuvelir, who claimed to be Yatavas of Dvarasamudra. The Sanskrit inscription in grantha characters in the Muvarkovil gives the genealogy of the Irukkuvel who are the staunch allies of Cholas and supported them in all their wars (Ayyar 2002b: 1030-1040). From Chola times down to 15th century, it had at least two *nakarams* (merchant corporation) namely *manigramam* which are affiliated to the great guild *ainnurruvar*. The sluice inscription that found installed in the tank behind the Musukundesvarar temple complex further supports this view.

The architectural features and the Pallava grantha inscription in the central shrine datable to Bhuti Vikramakesari, an ally of Chola king Parantaka II (956-973), clearly suggest that this temple Muvar kovil belongs to the early Chola period. Another early Chola shrine was built by Mahimalaya Irukkuvel (also called Parantaka Veera Chola) in 921 A.D. during the 14th regnal of the Chola king Parantaka (907-953 A.D.). The plinth portion of the Aivar kovil built during the 8-9th c. A.D. was exposed a little to the southeast of Muvar kovil.

The Megalithic burial complex mainly consists of cairn circles entombing cist burials. The circles are built of granite blocks. The huge Megalithic site that found further west of Kodumbalur at Virutapatti and the Pallava king Nandivarman inscription found in the sluice at Rasalipatti further supports its early date (Fig. 9).

Another important site, Kudumiyanmalai, is 19 km northwest of Pudukottai on the Pudukottai-Manapparai road. A second Tamil Brahmi inscription of this district was discovered at this site. Early inscriptions referred to this site as *tirunalakkunram* meaning 'the sacred and prosperous hill'. Later the word *nala* (in prosperity in Tamil) was sanskritised and associated with the Puranic king Nala. Later inscriptions call this site *Sikhanallur*. *Sikha* is the Sanskrit for *kudumi* that means a 'lock of hair'. According to the local legend a temple priest once gave his sweet-heart the flowers intended for divine worship, and when the ruler came unexpectedly, the priest offered him as *prasadam* the flowers that that lady had worn. On seeing a hair in the *prasadam*, the ruler sought the explanation from the priest. To conceal his offence the priest asserted that the God had natural hair. To save the priest, a *kudumi* appeared on the *lingam*. Since then, the site is called as *kudumiyanmalai*. The famous music inscription datable to the 7th century A.D. is engraved on the rock to the south of Melakkovil and between the two Ganesas. In all, there are more than 120 inscriptions. The rock-cut cave shrine Melakkovil or *Thirumerrali*, the monolithic sculptures in the Siva temple, the Subrahmanya temple are the some of the fine examples at this site (Ayyar 2002b: 1041-1053). C.Santhalingam during his exploration in 1981 discovered the Tamil-brahmi inscription refered to earlier on the southern side of a natural cavern. The inscription, datable to 2nd –3rd century A.D. on the palaeographical grounds, is engraved on the rock bed donated by one Korrantai who hails from a village *nalal* (Santhalingam 1999: 1-3). The inscription reads as:

nalal korrantai pa[l]i

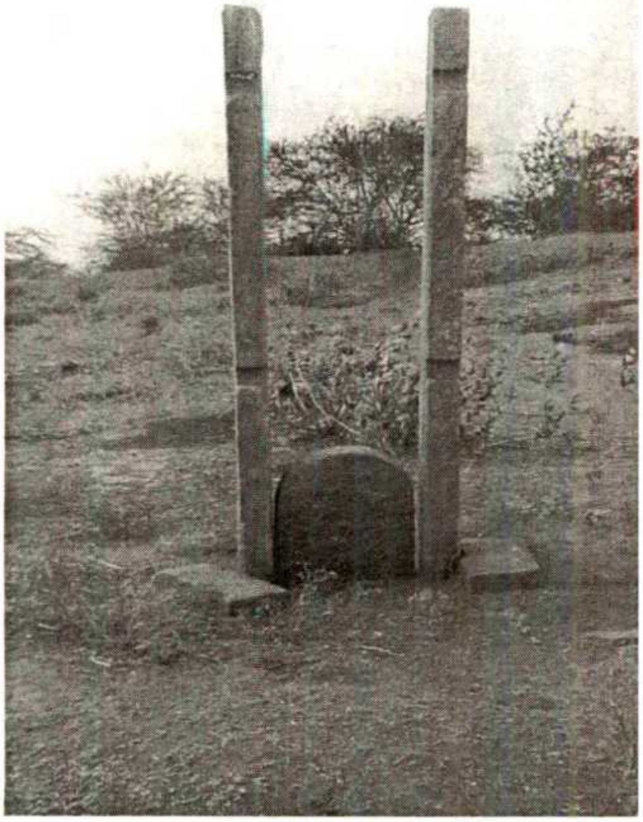


Fig. 9: Rasalipatti: Sluice with Pallava Nandivarman II Inscription

Roman Coins

The discovery of a 501 gold coin hoard at Karukkakurichi in 1898 suggests contacts with the Roman world. S.F. Hill (Table 3) who examined these coins reported that nearly 461 were defaced (Ayyar 2002a: 536-537). However he identified almost all of them ranging from Augustus times to Vespasianus.

Table 3: List of finds as reported by S.F. Hill

Issuer/s	Number
Augustus	40
Tiberius	163
Tiberius and Augustus	6
Nero Drusus	11
Antonia, wife of Nero	15
Germanicus and Caligula	8
Agriappa, wife of Germanicus	1
Caligula	5
T. Claudius	89
Claudius and Nero	5
Agriappa and Claudius	22
Agrippa and Nero	10
Nero	123
Vespasianus	3
Total	501

In Tamil Nadu, the Coimbatore region predominates as far as discoveries of Roman coins are concerned. Here over 26 separate finds ranging from huge quantities of coins to single coins. Out of 3467 reported coins 77 were of gold and 3390 were of silver in which Augustus and Tiberius coins predominate (Suresh 1992: 61-70). These Roman coins were found, although in hoards, along the trade routes thereby indicating their association with trade.

All the Megalithic and Early Historic sites are generally associated with Jain centres. Even the early temples datable to 8-9th century A.D. are also constructed at these centres. For instance, the places like Narttamalai, Tiruveppur, Sittannavasal, Kodumbalur and a host of other historical sites were previously Jain centres. Even today, one can see Jain sculptures in these sites (Fig. 10). The arrival of Jainism in the Pudukottai area would have followed the same route, which the Megalithic people followed in the previous years. All the early Jain centres are invariably dotted with Megaliths. These findings suggest that the Jain monks would have converted the existing Megalithic people to Jainism. All the important Jain centres were located along the trade routes. Therefore, the erection of megaliths, construction of tanks, spread of Jainism, formation of trade routes and all other related cultural indicators should not be seen in isolation. One needs to integrate the archaeological, epigraphical, numismatic and literary sources to understand the complete picture of a region. Besides, comprehensive explorations supported with systematic excavations are utmost important to give a good picture on the various cultural process that had taken place in different chronological frames. Further, the archaeological investigations in the neighbouring regions are necessary to understand the emergence of various cultural traits in wider perspective. Otherwise, a distorted picture would emerge. Keeping the above factors in mind, the findings that obtained through the archaeological investigations in Pudukottai region are placed before the scholars for further investigations.

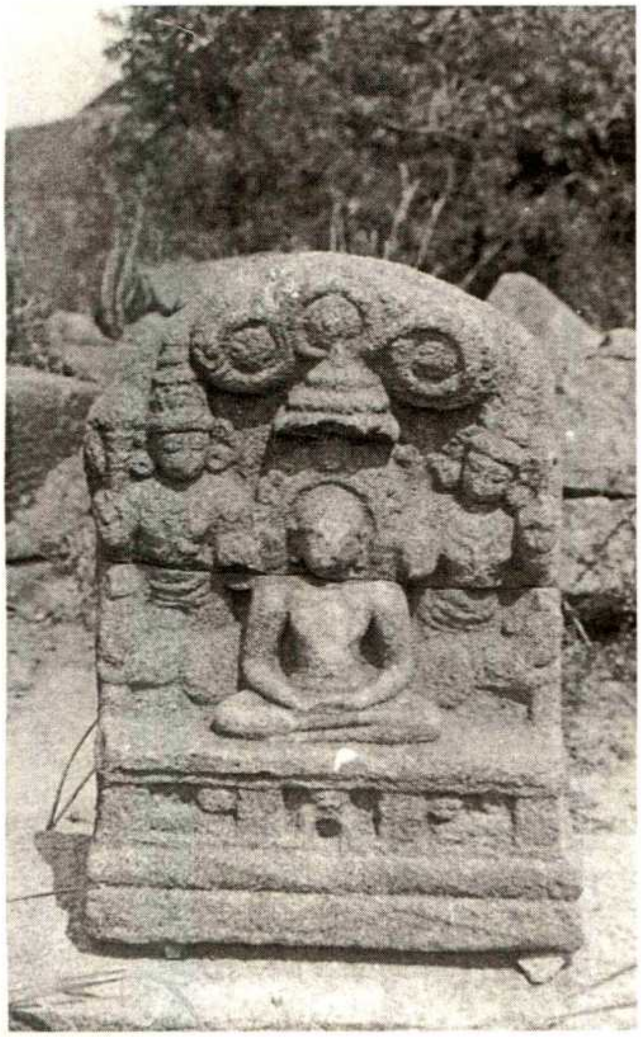


Fig. 10: Mayilappatti: Jain Sculpture

Acknowledgement

This paper is part of project work funded by the Indian Council of Historical Research. I am grateful to the ICHR for the financial support. I also owe a lot to Sri. Karu. Rajendran of Melappanaiyur, Pudukottai District for his active participation in the field.

References

Ayyar, Venkatarama K.R. 2002a. *A Manual of Pudukkottai State*, Vol. 2(1). Chennai: Commissioner of Museums, Government of Tamil Nadu.

Ayyar, Venkatarama K.R. 2002b. *A Manual of Pudukkottai State*, Vol. 2(2). Chennai: Commissioner of Museums, Government of Tamil Nadu.

Gandhi, Gopalkrishna 1983. *Tamil Nadu District Gazetteers – Pudukottai District.* Chennai: Government of Tamil Nadu.

IPS - Inscriptions of Pudukottai State, Part I and II (reprint). 2002. Chennai: Commissioner of Museums, Government of Tamil Nadu.

Rajavelu, S. 1995. Sittannavasal kala aaivu (Exploration at Sittannavasal), *Avanam, Journal of Tamil Nadu Archaeological Society* 6: 9-12.

Rajendran, Karu 1989. Kumulikalvettukkal (Sluice Inscriptions). *Kalvettukalil ceitanavum ceiyavenduvanavum,* Seminar papers, unpublished.

Rajendran, Karu 1991. Pudukottai mavatta kumilik kalvettukkal (Sluice Inscriptions of Pudukottai District), *Avanam* 1: 39-39.

Rajendran, Karu 1993. Pudukottai mavatta kumilik kalvettukkal (Sluice Inscriptions of Pudukottai District), *Avanam* 3: 13-16.

Rajendran, Karu 1997. Putiya kumili kalvettukkal (New Sluice Inscriptions), *Avanam* 8: 23-27.

Ramachandran, K.S. 1979. Excavation at Sittannavasal, District Pudukottai, *Indian Archaeology — A Review* 1975-76: 39-42.

Ravi, S. 2001. Vilankurichi Nirpacanakkalvettu (Vilankurichi Irrigation Inscription), *Avanam, Journal of Tamil Nadu Archaeological Society* 12: 86.

Sasisekaran, B. and B. Raghunatha Rao 1999. Technology of Iron and Steel in Kodumanal — An Ancient Industrial Centre in Tamil Nadu, *Indian Journal of History of Science* 34(4): 263-272.

Santhalingam, C. 1999. Kudumiyanmalai Tamil-Brahmi Inscription, *Avanam* 10: 1-3.

Shanmugam, Kodumudi 2001. Erikalil kal avanangkal (Stone records in Tanks), in *Tamilil Avanagkal.* (A. Dasarathan *et al.* Eds.) Chennai: International Institute of Tamil Studies.

Srinivasan, K.R. 1946. Megalithic Burials and Urn-fields of South India in the Light of Tamil Literature and Tradition, *Ancient India* 2: 9-16.

Subbarayalu, Y. 1991. Pulankurichchi kalvettukkal (Pulankurichchi inscriptions), *Avanam* 1: 57-69.

Suresh, S. 1992. *Roman Antiquities in Tamil Nadu.* Chennai: C.P. Ramaswami Aiyar Institute of Indological Research.

Virasamy, M. 1991. Kalingkuk Kalvettu (Sluice Inscription), *Avanam* 1: 14.

Onshore Excavation at Bet Dwarka Island, in the Gulf of Kachchh, Gujarat

A.S. Gaur and Sundaresh

National Institute of Oceanography
Dona Paula
Goa 403 004

Abstract

Several ancient habitational sites were discovered in the coastal area of Bet Dwarka island during the last two decades of marine archaeological exploration. A large amount of protohistoric and historical pottery was collected from the sites. An excavation was undertaken at Bet Dwarka during 2001-2 to obtain a cultural sequence of the island. The following cultural sequence was observed from the excavation. The remains of the Late Harappan period were found near Balapur village on the island. This is a single culture site. A large number of potsherds including carinated dishes, bowls, and jars were recovered. A few sherds with black painting on red were also collected. Important antiquities from this trench include a copper fish-hook and an antimony rod. The remains of the historical period were noticed over a large area of the island. Three trenches were laid on the southern coast. The important activity during this period was the exploitation of marine resources like different types of shells and fish. The important factor which led to a continuous habitation at Bet Dwarka was the availability of marine shells which were exploited on a large scale. The island also served as a safe harbour.

Introduction

A large number of sites associated with the Harappan civilization have been discovered in Gujarat during the last quarter of the 20th century and many of them have been excavated extensively. Archaeological discoveries indicate that maritime activities including trade and commerce were important in Gujarat since the Harappan times (Rao 1979). During the last two decades extensive offshore explorations have been undertaken along the Gujarat coast especially in Okhamandal region where modern Dwarka is situated. Following the lead from literary references, a massive underwater archaeological investigation was launched in Dwarka, Bet Dwarka and Somnath waters. There are a fairly large number of finds from Bet Dwarka dating from the protohistoric period to the modern times. The island of Bet Dwarka is located at the mouth of the Gulf of Kachchh and archaeological evidence suggests that it played a significant role in maritime activities in the past. To obtain a proper cultural sequence and understand the human-sea relationship, an onshore excavation was carried out in the 2001-02 season. The present paper reports the findings from this excavation.

The island of Bet Dwarka is situated in Okhamandal taluka of Jamnagar district of Gujarat. It is 3 km away from the mainland and the nearest port is Okha. It is 13 km long (NW-SE) and 4 km wide. The southeastern part of the island consists of high cliffs and clayey beaches, while to the northwest is a low lying area with fine sandy beaches. The vegetation includes shrubs, cactus and a few neem trees. Some land is cultivated. The main crops are maize and *bajra*.

Previous Work

The earliest excavation on the island was carried out by Hiranand Shastri in the 1930s and dated the earliest habitation to the 3rd century B.C. (Rao 1987). However, onshore explorations in 1969-70 brought to light a large number of potsherds of periods ranging from the Late Harappan to the Medieval period (IAR 1969-70). Extensive onshore and offshore exploration by the Marine Archaeology Centre of NIO, Goa, during the last two decades yielded similar results (Rao 1987; 1988; 1999; Rao and Gaur 1993; Sundaresh and Gaur 1998; Gaur 2000; Gaur *et al.* 2000). Thermoluminescence dates obtained on 9 potsherds from the earlier surface explorations (Table 1) suggest that the earliest habitation on the island commenced in the mid-second millennium B.C. (Vora *et al.* 2002). Recently offshore explorations brought to light a large number of stone anchors of the Medieval period, a lead anchor and remains of amphorae of the Early Historic period (Sundaresh *et al.* 2002).

Table 1: TL Dates from Bet Dwarka island supplied by Wollogong University of Australia

No.	Site	Lab Ref.	UncorrectedTL Dates	Corrected for fading
1	BDK-VI	W-2876	3260±470	3380±490
2	BDK-I	W-2877	2460±330	2790±370
3	BDK-VI	W-2878	2300±200	2430±210
4	BDK-I	W-2879	1380±150	1440±160
5	BDK-I	W-2880	1960±160	2140±170
6	BDK-I	W-2881*	740±50	890±60
7	Khuda Dost site	W-2882	1000±170	1060±180
8	BDK-II	W-2883	1270±380	1370±410
9	BDK-I	W-2884	970±120	1060±130

* This sample (W2881) exhibited a TL fading factor of more than 20% over the period of the test. This casts a degree of doubt upon the reliability of the final TL age

The Excavations

Six trenches were laid in different parts of the island (Fig. 1). Among them three trenches namely BDK-I (5 x 5 m), II (5 x 2.5 m), III (5 x 2.5 m), were dug in the southeast coast of the island near the Nilakanth Mahadev temple. BDK-IV, near the Khuda Dost Dargah was scraped while BDK-V (2.5 x 2.5 m) was laid out in Sundarvan, south of the present Balapur village. BDK-VI (2.5 x 2.5 m) was laid in agricultural land near Par village. The excavation was carried out to the virgin soil in each trench. The layers were distinguished on the basis of color, composition and texture. A brief findings from each sites are given below.

BDK-I

The excavation was carried out up to a depth of 2.65 m and 9 layers identified. The foundations of two structures were found in this trench (Fig. 2). The structure is made of irregular stone blocks with mud as a binding material. The structure has an extension towards the southern side. The structure appears to be a part of a room of a house-complex. On the other side of the structure, in the same trench, a hearth and flooring was found, which, might have been a part of a kitchen. The size of this room is 3 x 3 m, with a what appears to be a door on the northern side, which, however, had been enclosed later. Two other adjoining structures were noticed on either side. A few areca-nut shaped terracotta beads (Fig. 3) are the important antiquities contemporary to this structure. Shell artefacts like bangles and beads were also noticed. Other important finds include a broken decorative sandstone block. This block depicts a seated lion and floral design. A copper ear ring was also recorded from this trench.

From layer 6, two copper coins of the Kushana period;one awl and one stylus of bone; and a large number of iron objects including nails, sickles, arrowheads were found. More than 50% of artefacts from layer 6 and 7 are of shell and the rest are potsherds.

The important potsherds include Red Polished Ware, Plain Red Ware and a few sherds of Black Ware. The major shapes are jars of different sizes, bowls of various types such as bowl with in turned sharpened rim, bowl with featureless rim, bowl with an internally ribbed rim, dishes, lids, basins and cooking vessels. Basins were found of different sizes, often with a flange on the exterior.

The habitation started on slope of the hill area and extended towards the shore area. Presently the lowest remains of habitation are limited to about a metre parallel to the shore with the remains towards the offshore eroded. The lowest cultural level in the trench is lower than present high water line by about 60 cm.

BDK-II

The trench was laid at the highest point in southern coast of the island. A total habitational deposit of 3.45 m was noticed with 11 layers. The initial habitation was lying on a sloping area that extends in a similar manner to BDK-I. However, at later stage the habitation was also extended in the opposite direction. The foundation of a structure was noticed in southeast corner of the trench. The structure was

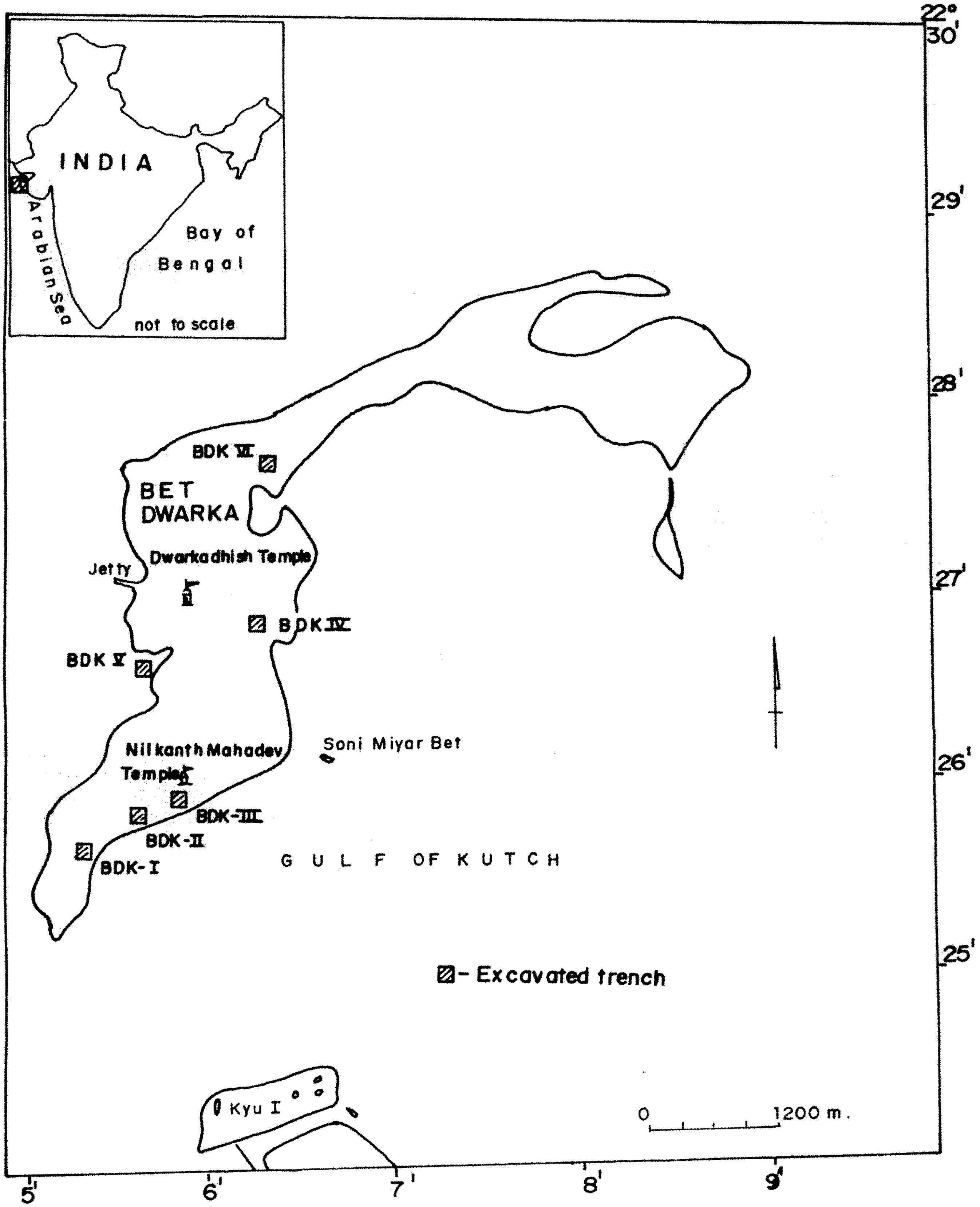


Fig. 1: Location of Bet Dwarka island

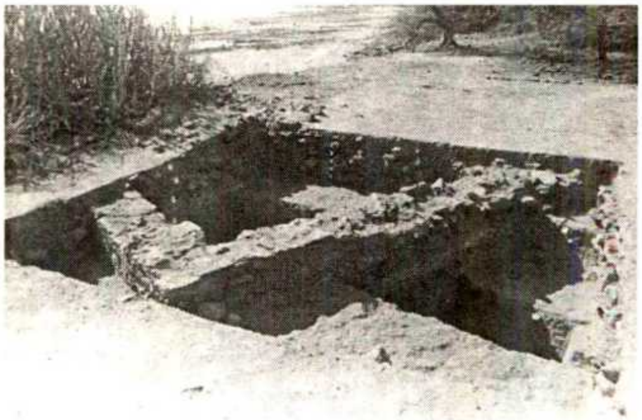


Fig. 2: Bet Dwarka: stone structures of phase III of historical period exposed in BDK-I

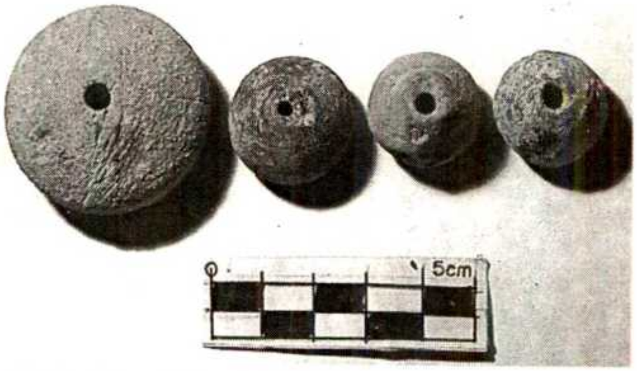


Fig. 3: Bet Dwarka: terracotta beads from BDK-I

sealed by layer 3 and the foundation of structure runs up to layer 4. A number of disturbed blocks were noticed in layer 3 and 4 which are the remains of some collapsed structure. Shell artefacts including beads and broken bangles were recovered from this trench. A large number of potsherds was collected from all the layers. The pottery comprises of Red Polished Ware, Red Ware and a few sherds of Black Ware. The important shapes are bowls, basins, jars, dishes, different type of lids and cooking vessels. One of the sherds of a Red Polished Ware bowl has a Brahmi letter 'A' (Fig. 4). A few other graffiti marks were also noticed. A large number of iron artefacts were also noticed from this trench which include sickles, nails, arrowhead, rings, etc. The lowest cultural level in the trench is lower than present high water line by about 70 cm. A study of the layers by the seismologists suggest that layer 10 is formed by the liquefied material thus providing the evidence of earthquake during early centuries of the Christian Era (Rajendran *et al*. 2003).

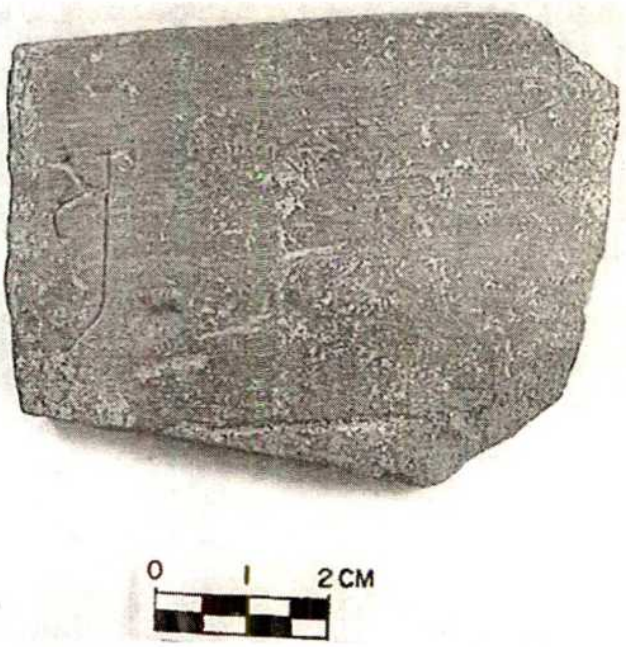


Fig. 4: Bet Dwarka: Red Polished ware sherd with Brahmi letter "A" from BDK-II

BDK-III

The trench was laid on the eastern side of the trench BDK-II near the present water pump house. A total deposit of 2.35 m was found in which 10 layers were identified. It was noticed that the foundation of a structure was sealed by layer 6 and it ran through layer 7 and 8 (Fig. 5). The structure is made of bigger stone blocks compared to other structures noticed at BDK-I and II. The exposed portion of the structure was in a 'L' shape, and possibly extends towards the south and west, probably being part of a house complex. Important shell artefacts such as beads and bangles besides a large number of wasted shells were found. One small copper coin, still unidentified, was also recovered from this trench. A number of terracotta beads, balls, a toy-cart, wheel with painted spokes were noticed from the lower level. A carnelian bead, glass beads and a pestle were important finds besides a few iron artefacts. Plain Red ware, Red polished ware, Red burnished ware, Black ware and a few Grey ware sherds were found. The important shapes are jars, basins, dishes, bowls, cooking vessels and lids.

BDK-IV

The trench was laid out at eastern side of the island, in agricultural land known as Sundaravan, located south of the village Balapur. A large number of potsherds were collected earlier from the surface. However, during the excavation no artefacts were recovered. Excavation was stopped after digging up to 75 cm.

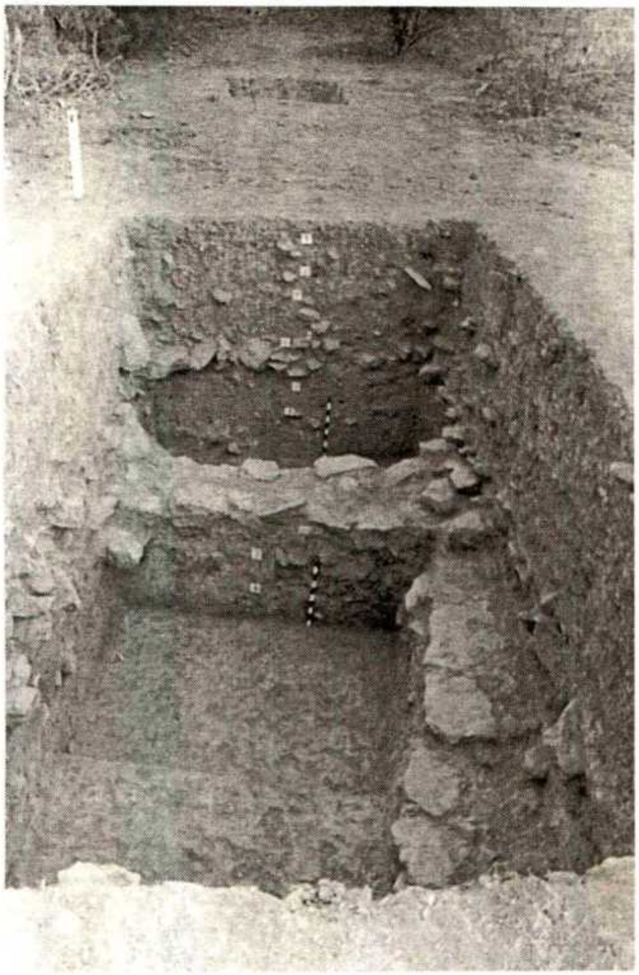


Fig. 5: Bet Dwarka: stone structures of phase I of historical period exposed in BDK-III

BDK-V

The site is near Khuda Dost Dargah on western coast of the island. This site gets submerged during high tide. During the low tide, the section facing towards the sea was scraped and pot sherds and broken shell bangles were recovered from this place.

BDK-VI

The trench was laid in an agricultural land east of the village Par near a Mosque. The antiquities and pottery collected earlier from this location were associated with the Late Harappan phase (Sundaresh and Gaur 1998). The habitational deposit was noticed up to a depth of 95 cm and 2 layers were identified. A large stone block on western section of the trench was encountered which could be of some structure. However, continuity of the same could not be traced. The important finds include a large copper fish-hook (Fig. 6) and a copper antimony rod besides a large number of dentalium beads, broken shell bangles and waste of shells. Pottery includes Plain Red Ware, Painted Red Ware, Buff Ware and Black Ware. The major shapes are carinated dishes, convex sided and stud handled bowls, jars and miniature vessels.

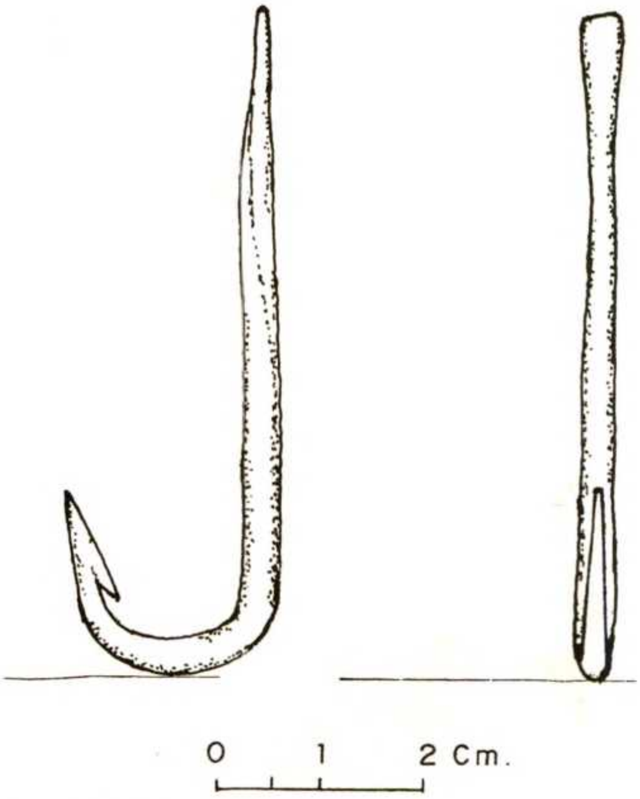


Fig. 6: Bet Dwarka: copper fish-hook

Discussion

The habitation of the island commenced at the beginning of the 2nd millennium B.C. and continued until today at different places in different times. From the above findings the following cultural sequence has been reconstructed:

Protohistoric period

This is the first habitation located in northeastern part of the island near Par village on flat and high tableland. The pottery and antiquities clearly indicate that they belonged to the Late Harappan phase and are very similar to other Late Harappan sites of Saurashtra region. The primary reason for the settlement may be the availability of shells which have been exploited to a great extent by the Harappans in Gujarat. Possibily, the Harappans from Nageshwar migrated to the island of Bet Dwarka which is situated just opposite to Nageshwar on the mainland. Hegde *et al*. (1990) report that Nageshwar shows Sindhi Harappan traits without the influence of Saurashtra and Kachchh Harappan traits. However the pottery at Bet Dwarka is very similar to the Late Harappan sites of

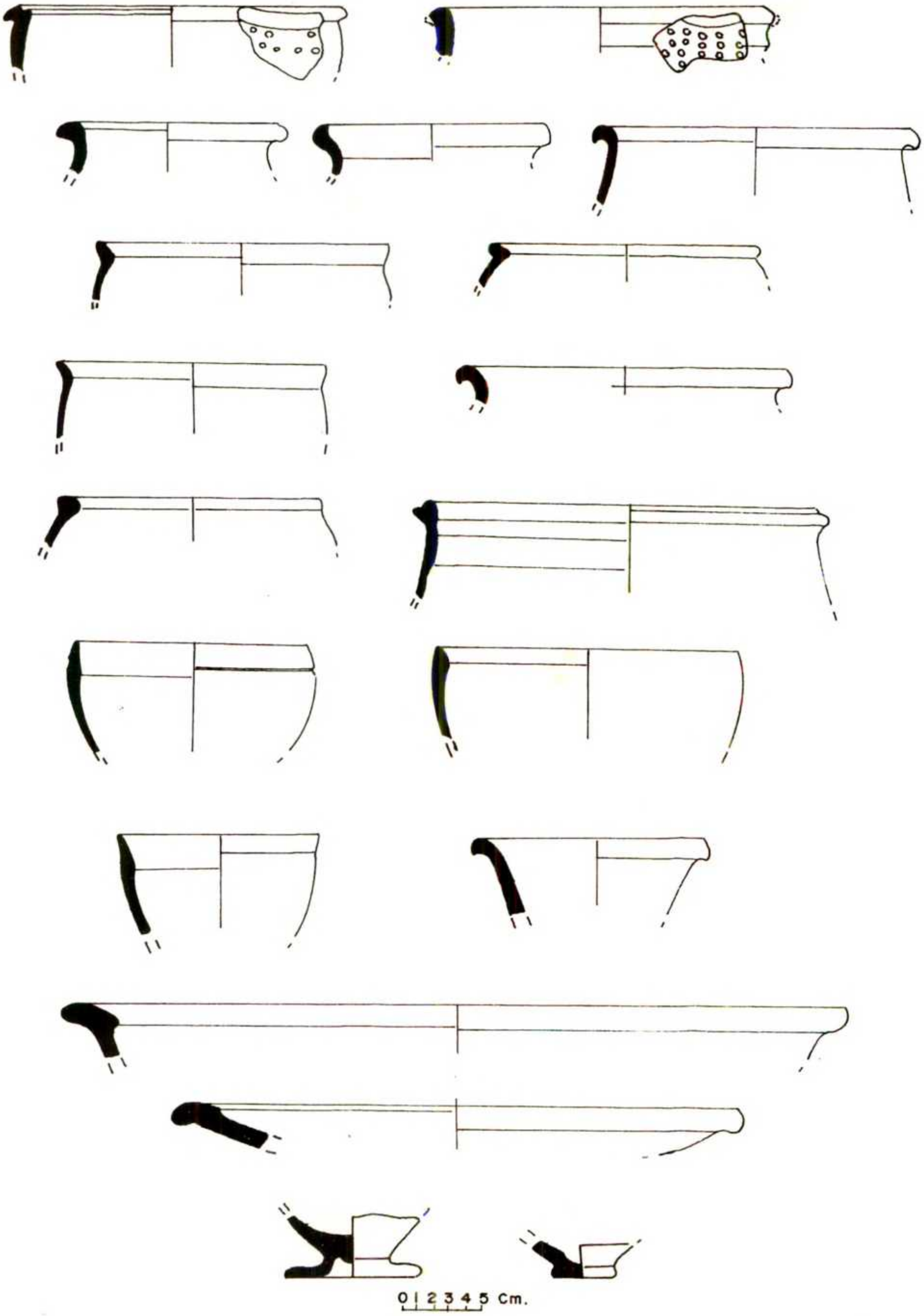


Fig. 7: Late Harappan pottery from Bet Dwarka

Saurashtra specially Rangpur IIC. A stud handled bowl, a characteristic feature of Gujarat Harappans, is found here. Coarse Red Ware, Buff Ware and Black Ware sherds are also found from Bet Dwarka. Convex-sided bowls, carinated dishes, jars and miniature vessels similar to the other Saurashtra Harappan sites are found (Fig. 7). Also, a few sherds of perforated jars were observed from surface explorations. A well-preserved copper fish-hook suggests that they were fishing in deeper waters and a large number of fish bones were also found from the excavated site. The fish-hook is very similar to those reported from Mohenjo-daro (Marshall 1973), Harappa (Vats 1974), Lothal (Rao 1979) and Padri (Shinde and Thomas 1993). The fish-hook of Bet Dwarka is measures 7 cm in length, while the biggest fish-hook reported from the Harappan levels at Padri is 14 cm long. The economy of Late Harappans in Bet Dwarka was based on marine resources as there is no fertile agricultural land in the island. The excavation has not revealed the evidence of any house planning which may suggest that this island might have been a seasonal habitation. Radiocarbon and TL dates from this site indicate a time bracket for the habitation between 1600 and 1400 B.C. (Table 2).

Historical period

During the Early Historic period the island was inhabited at many places and huge deposits were noticed at BDK-I, II, III and V. During this period maritime activities were at their zenith and the island was visited by foreign boats. This period can be divided into three phases without any significant break on the basis of pottery and other antiquities.

Phase I

The evidence occurred from the lowest level of BDK-I and BDK-III where pottery similar to that at Prakash, Amreli and Hastinapur, where it is associated with NBP, was encountered. The habitation was concentrated on a sloping area along the present shoreline and the remains of this phase have been destroyed by the sea resulting in a lot of pottery and antiquities being exposed during low tide from the inter-tidal zone (Gaur *et al.* 1994). Pottery of this phase comprises Red Ware with a thick slip and burnished surface. Different types of bowls, dishes, jars, ring footed vessels and cooking vessels were important finds. Pottery is made on a well-levigated clay. However, uniform firing is lacking because an un-oxidized core has been noticed in all the vessels. A thick coat of slip which has been burnished was noticed on the vessels. Important antiquities of this period are a carnelian beads, terracotta toy carts, wheels, beads of fish bone, terracotta, shell and glass. A large number of shell bangles and collumellae were noticed from this phase. Radiocarbon and TL dates for this phase suggest a time bracket between the fifth to the first century B.C. The important finds of this phase are a few shapes of bowls, which are similar to the Late Harappan pottery, especially Rangpur III. However, some more data are required in order to consolidate the aspects. The remains of houses were not encountered, perhaps, due to limited excavation.

The measurement of present high water line and the earliest levels of Historic period suggest that the sea level was lower at least by 2 m during this phase as the habitation was concentrated towards present inter-tidal zone and has been destroyed. Remnants of the same are encountered in the layer extending towards the offshore.

Table 2: Radiocarbon dates from Bet Dwarka Island sample collected during the excavation in December 2001and analyzed by Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow

No.	Site	NIO Sample No.	Depth in cm	Layer	BSIP Lab number	C14 date Year in BP	Calibrated date
1	BDK-I	BDK-I /charcoal/2001/20	70	4	2010	3600±90	4070-3730*
2	BDK-II	BDK-IIshell/2001/21	240	8	1998	1940±80	1990-1820
3	BDK-II	BDK-II/shell/2001/22	275	10	1996	2000±80	2040-1870
4	BDK-III	BDK-II/charcoal/2001/23	70	4	2005	2200±100	2340-2060
5	BDK-III	BDK-II/charcoal/2001/24	225	9	2009	2590±100	2780-2500
6	BDK-VI	BDK-VI/shell/2001/26	50	2	2000	3140±100	3470-3260
7	BDK-VI	BDK-VI/shell/2001/27	20	1	1993	3470±80	3830-3640

* this date is not corresponding to the archaeological findings as from this layer Kushana coins were collected.

Phase II

During this phase population increased manyfold and a lot of maritime activity is recorded. Regular house building activity was noticed as one of the trenches revealed the foundation of a wall which is L in shape and extends towards the western and northern sides of the trench. The structures were made of irregular stone blocks and mud mortar was used as binding material. A lots of pottery continued from phase I, however, Burnished Red Ware sherds were not encountered and there was a substantial decrease in dishes and ring-footed vessels. A unique shape of bowl appeared which has a rib internally just below the rim and the frequency of the same increases in upper layers. Different types of bowls which include convex-sided, and bowls with flaring sides with a sharp rim are the important types pottery from this phase. The introduction of a lid with round flange in the middle, which is very similar to ink-pot type lid reported from many other Historic period sites is present. This particular variety of lid might have been used for covering jars and amphorae during transportation by boats as a similar type of lid is also reported from a suspected shipwreck containing amphorae and a lead ingot in Bet Dwarka waters. However, this needs confirmation with additional data. The exploitation of conch shell was at peak as shell artefacts in BDK-I layer 6 and 7 form more than 50% of the total finds. A large number of worked collumella, broken bangle, beads etc. have been recorded from this site. A lot of sherds of Red Polished Ware are also found during this phase. The important shapes are bowls and jars.

Copper coins which appear to be of Kushana kings were noticed from this phase. A lot of antiquities including beads of terracotta, glass, shell and semiprecious stones, awls, stylus, a pendant and a duck, made of bone are the important finds. Iron artefacts were found extensively from this phase which include arrowheads, sickles, and different types of nails. On the basis of archaeological finds and radiocarbon dates this phase may be dated between the first century B.C. and the second century A.D.

Phase III

This phase is found in the upper layers in BDK-I, II and III. Extensive structural activities were noticed during this period. A large room measuring 4 x 4 m was recorded in BDK-I, showing the presence of multi-roomed houses. The structures were made of small limestone blocks and mud mortar was used as binding material. A working floor with a hearth was also noticed from this phase. Pottery of the earlier phase continued but the clay used during this phase was not well levigated. A lot of sherds of Red Polished Ware also occurred and the frequency of ink-pot type lid increased substantially. Important antiquities of this phase include beads of glass, terracotta, shells and dentalium shells. A copper pendant, earring and finger rings are the important finds. A potsherd is engraved with a Brahmi letter 'A' which may be datable to the 3rd century A.D. On the basis of archaeological findings and radiocarbon dates this phase may be dated between the second and the fourth century A.D.

Another important point which may be mentioned here is that people of Bet Dwarka had greater contacts with Saurashtra than the Okhamandal region. The excavations at Dwarka in the Okhamandal region by Deccan College, Pune (Ansari and Mate 1966) and the Archaeological Survey of India (IAR 1979-80) suggest that Historical period pottery is different from the pottery of Bet Dwarka while the Bet Dwarka pottery has much more similarity with Saurashtra pottery of the Early Historical period.

Sea level considerations

The data on sea level changes in Gujarat coast suggests that the sea level was higher than the present by 2 to 6 m during 4000 years B.C. (Gupta 1977). This was the period when the Indian Subcontinent witnessed the rise of a well-developed civilization and Gujarat was a major province of Indus civilization. Higher sea level would have attracted Harappans to use tidal and back water channels for anchoring boats. There is ample evidence on the exploitation of marine resources along the Gujarat coast during Harappan times which continued untill the Late Harappan period as many Late Harappan sites are reported along the coast (Gaur and Vora 1999). Therefore, it may be reasonable to think that the sea level was higher even along the Bet Dwarka island until the Late Harappan phase as the lone Late Harappan site is found about 4 m above present high water line.

The lowest habitations in BDK-I and II are below the present high water line by about 70 cm. Similarly the site BDK-V near Khuda Dost Dargah is also flooded during the high tide. The time bracket of both sites is between the second century B.C. and fourth century A.D. During the early phase habitation extended towards the offshore and gradually extended landwards during the later stage. However, the remains of the later phase are also destroyed which suggest that up to 4th century A.D. the sea level was lower than the present. With this simple logic one may consider that the Early Historical period settlement took place on the island when sea level might have been lowered by 2-3 m compared to the present. If the sea level is lower by 2-3 m during early centuries of the Christian Era then a few places in Bet Dwarka island would have been connected to mainland during low tide. A local belief in this area that in the past people could reach the island by walking and bullock carts might reflect a past reality. Radiocarbon dates of the lowest level of BDK-II is 2040-1860 years B.P. Excavation of the present Dwarka suggests that around the Christian Era the sea level was lower than the present (Sankalia 1966) in Okhamandal area. In general, the sea level during Christian Era was lower than the present by 2-3 m. Another important point may be mentioned here is that untill the Medieval period the anchoring point for boats would have been near present Bet Dwarka jetty. A large number of amphorae, lead anchors and a lead ingot possibly from a shipwreck were noticed besides a large number of stone anchors datable between the Historical and Medieval periods.

Conclusion

The present excavation has thrown a light on the cultural sequence of Bet Dwarka Island. Around the 17th century B.C. Late Harappan people had established their settlement and they perhaps migrated from Nageshwar which is close by. They have exploited marine resources such as fish and conch shells. It appears that Late Harappans of Bet Dwarka island had interaction with the Saurashtra Harappans and they might be visiting ports on the coast of the northern Saurashtra region. The scanty habitational deposit suggests that the site was abandoned after a couple of centuries . The island was again inhabited during the 8th century B.C. on the southeastern coast of the island. However, at a later stage the habitation was vastly extended. Hectic maritime activities were witnessed during this period and Mediterranean boats also visited the island. The reference of Baraca may be identified with Bet Dwarka island. Perhaps one of the Roman ships was also wrecked here and that may be one of the reasons that the author of *Periplus of the Erythreanean Sea* has mentioned the difficult navigation in the Gulf of Baraca. The island continued to be an important centre of maritime activity until the emergence of the Okha port in the Okhamandal area. The discovery of a large number of anchors of different types near present jetty suggests that this point has served as an anchoring point of the ships for a long time.

Acknowledgments

We are thankful to Dr. E. Desa, Director, for his constant support for the preservation of cultural heritage and permitting us publish this paper. Thanks also due to Shri. K.H. Vora, Scientist-in-Charge of the Marine Archaeology Centre for going through the manuscript critically. Authors are grateful to Dr. David Price of Wollogong University of Australia for providing TL dates and Dr. Rajgopalan and Dr. Sekar of Birbal Sahni Institute of Lucknow for radiocarbon dates from Bet Dwarka Island. Shri. U.S. Sirsat and Shri. S.B. Chitari helped during the field work.

References

Ansari, Z.D. and M.S. Mate 1966. *Excavations at Dwarka.* Poona: Deccan Collage.

Gaur, A.S., Sundaresh, P. Gudigar, and Sila Tripati 1994. Protohistoric Ceramics of Dwarka and Bet Dwarka. *The Role of Universities and Research Institute in Marine Archaeology* Proceeding of Third Marine Archaeology Conference on Indian Ocean Countries (S.R. Rao, Ed.) pp. 165-172. Goa: National Institute of Oceanography.

Gaur, A.S. and K.H. Vora 1999. Ancient Shorelines of Gujarat, India, during the Indus Civilization (Late Mid-Holocene): A Study Based on Archaeological Evidences. *Current Science,* 77.1: 180-185.

Gaur, A.S. 2000. *Harappan Maritime Legacies of Gujarat*, New Delhi: Asian Publication Services.

Gaur, A.S., Sundaresh, P. Gudigar, Sila Tripati, K.H. Vora, and S.N. Bandodkar 2000. Recent Underwater Explorations at Dwarka and Surroundings of Okhamandala, *Man and Environment* XXV(1): 67-74.

Gupta, S.K. 1977. Quaternary Sea-level Changes on the Saurashtra Coast, in *Ecology and Archaeology of Western India* (D.P. Agrawal and B.M. Pande, Eds), Delhi: Concept Publication.

Hegde, K.T.M., K.K. Bhan, V.H. Sonawane, K. Krishnan and D.R. Shah 1990. *Excavation at Nageswar-Gujarat,* Vadodara: M.S. University Baroda.

IAR: *Indian Archaeology: a Review* — 1969-70. Annual Bulletin of the Archaeological Survey of India, New Delhi.

IAR: *Indian Archaeology: a Review*-1979-80. Annual Bulletin of the Archaeological Survey of India, New Delhi.

Marshall, J. 1973. *Mohenjo-daro and the Indus Civilization*, Delhi: Indological Book House.

Rajendran, C.P., R. Kusala, K.H. Vora, and A.S. Gaur 2003. Odds of a seismicsource near Dwarka, NW Gujarat: An evaluation based on proxies. *Current Science* 84.5: 695-701.

Rao, S.R. 1979. *Lothal — A Harappan Port Town,* Part-I, New Delhi: Archaeological Survey of India.

Rao, S.R. 1987. *Progress and Prospects of Marine Archaeology in India.* Goa: National Institute of Oceanography.

Rao, S.R. 1988. Excavation of Submerged Ports-Dwarka a Case Study, in *Marine Archaeology of Indian Ocean Countries*, (S.R. Rao Ed.), pp. 47-53. Goa: National Institute of Oceanography.

Rao, S.R. 1999. *The Lost City of Dvaraka.* New Delhi: Aditya Prakashan.

Rao, S.R. and A.S. Gaur 1992. Excavation at Bet Dwarka, *Journal of Marine Archaeology* 3: 42-47.

Sundaresh and A.S. Gaur 1998. Archaeology of Bet Dwarka. *Man and Environment* XXIII(2): 77-86.

Shinde, V.S. and E. Thomas 1993. A Unique Harappan Copper Fish Hook from Padri, Gujarat, *Man and Environment* XVIII: 145-147.

Sundaresh, A.S. Gaur, Sila Tripati, P. Gudigar and S.N. Bandodkar 2002. Stone Anchors from Bet Dwarka Island, Gujarat Coast, India: Significance to historical period maritime activities, *Bullentin of the Australian Institute of Maritime Archaeology* 26: 43-50.

Vats, M.S. 1973. *Excavations at Harappa*, Varanasi: Bhartiya Publishing House.

Vora, K.H., A.S. Gaur, David Price and Sundaresh 2002. Cultural Sequence of Bet Dwarka Island based on Thermoluminescence Dating, *Current Science*, 82.11: 1351-1356.

Discovery of the Ancient Port of Chaul

Vishwas D. Gogte

Department of Archaeology
Deccan College
Pune 411 006
Email: vgogte@hotmail.com

Abstract

Although Chaul has been often mentioned in the ancient literature as a major port on the west coast of India, Early Historic and the later period archaeological evidence has been found for the first time at Chaul. The occurrence not only of the characteristic Satavahana pottery but also ring-wells, coins, saddle querns, glass beads and bangles of the Satavahana period has been recorded at several places on the old mud flat of the Kundalika river. A body sherd of a Roman amphora was found in a trench along with a human skull in the Satavahana strata. A large variety of the Chinese and the Islamic glazed pottery were found on the old mud flat. An ancient embankment wall and a dilapidated stone structure resembling a jetty have been located on the edges of the old mud flat.

Introduction

Chaul, known as *Campavati* or *Revatikshetra* in the epic *Mahabharata*, is a place of great antiquity and appears in many ancient literary sources with many transliterations such as Chemula, Timulla, Symulla, Semulla, Chimolo, Sibor, Saimur and Cheul. In the Kanheri cave inscriptions (130 A.D.) mention is made to two brothers from Cemula who made gifts to the monastery and that 'one cistern is the gift of a goldsmith *Sulasdatta* of Chemula' (Bombay Gazetteer 1882: 172). Ptolemy (150 A.D.) states that he gained information about Western India from people who had come from Semulla to Alexandria (Sastri 1927: 42-3). In *the Periplus of the Erythraean Sea,* written in the first century, Semulla has been described as the first local mart south of Kalliena (Huntingford 1980; Schoff 1912). Warmington (1974: 289) attributed the rise of Chaul as a flourishing port to cotton trade from the times of the Roman Emperor Vespasian (69 A.D.).

In the Kanheri inscriptions Chemula is again mentioned in the fifth century A.D. where the excavation of the cave was funded by a merchant. He is described as 'famous among the millionaires of the great city of Chemula as one whose widespread fame had bathed in the three seas' (Bombay Gazetteer 1882: 173). Kosmas Indikopleustes in his work *Christian Topography* (525 A.D.) refers to Chaul as Sibor, a leading place of trade. It has also been inferred that the Chinese pilgrim Hiuen Tsang (642 A.D.) had visited Cimolo during his pilgrimage (Maharashtra State Gazetteers 1964: 718).

In the accounts of several Arab travellers such as Masudi (915 A.D.), Muhalhil (941 A.D.), Al Istakhri (950 A.D.), Ibn Haukal (976 A.D.), Al Biruni (1030 A.D.) and Al Idrisi (1130 A.D.), Chaul has been mentioned as either Saimur or Jaimur. In the later centuries also Chaul was visited by many European travellers such as Nikitin (1470 A.D.), Barbosa (1514 A.D.), Fitch (1584 A.D.) and several others. In a copper plate grant of the Silahara king Anantdev (1094 A.D.), the status of the port at Chaul was equated with that of *Shurparaka* (Sopara) and *Shristhanaka* (Thana) (Maharashtra State Gazetteers 1964: 717-19).

In spite of these profuse references to Chaul as a major trading centre on the West Coast of India, archaeological evidence not only of the Early Historic period but also of the subsequent periods had not been identified. Ghate (1990) did some geomorphological investigations at Chaul but did not identify any archaeological remains. Due to thick vegetation and coconut and betel nut plantations in the coastal areas, it is hard to find ancient habitational deposits. An ideal place for an ancient port would be in a creek a little away from the sea, at the mouth of a river. However, it could have been affected by the incursion of the sea or frequent fluctuations in the flow of the river. Due to this process, the ancient port sites might have either got buried under the fluvial and/or marine deposits or become inoperative due to the movement of rivers away from the sites. It is, therefore, imperative to study the probable geomorphological changes before exploring the areas for locating an ancient port site. An exercise involving the study of maps of Chaul of different periods proved fruitful in locating the habitational areas of the Early Historic and the later periods.

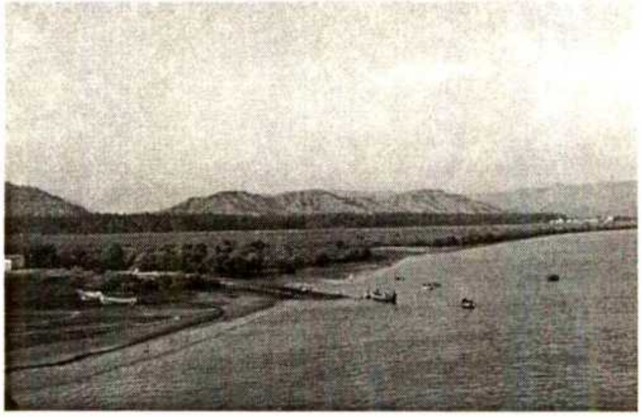


Fig. 1: General view of Chaul as seen from the mouth of the Kundalika river. The archaeological deposits are located in the darker strip of coconut plantation on the old mud flat. The Buddhist caves are in the background hills.

The Site

Chaul (18° 33' N; 72° 56' E) lies at the western end of the right bank of the Kundalika river or Roha creek (Fig. 1). A simple comparison of maps of 1924 and 1978 showed that there is reclamation of land even during the past seventy years as the Kundalika river moved away from Chaul. Two mud flats, one modern and the other ancient, could easily be identified between the town at Chaul and the present course of the Kundalika river. The older stabilized mud flat is about 1.5 m higher than the present high tide level. (Fig. 2) Its, nearly, two km stretch parallel to the river could have been an ideal area for the ancient port activity as the river must have flowed close to its the southern end, well protected from the strong action of wind and tidal waves.

Exploration of this area was difficult as it is covered under coconut plantations and thick vegetation. However, intensive explorations in this area gave the complete

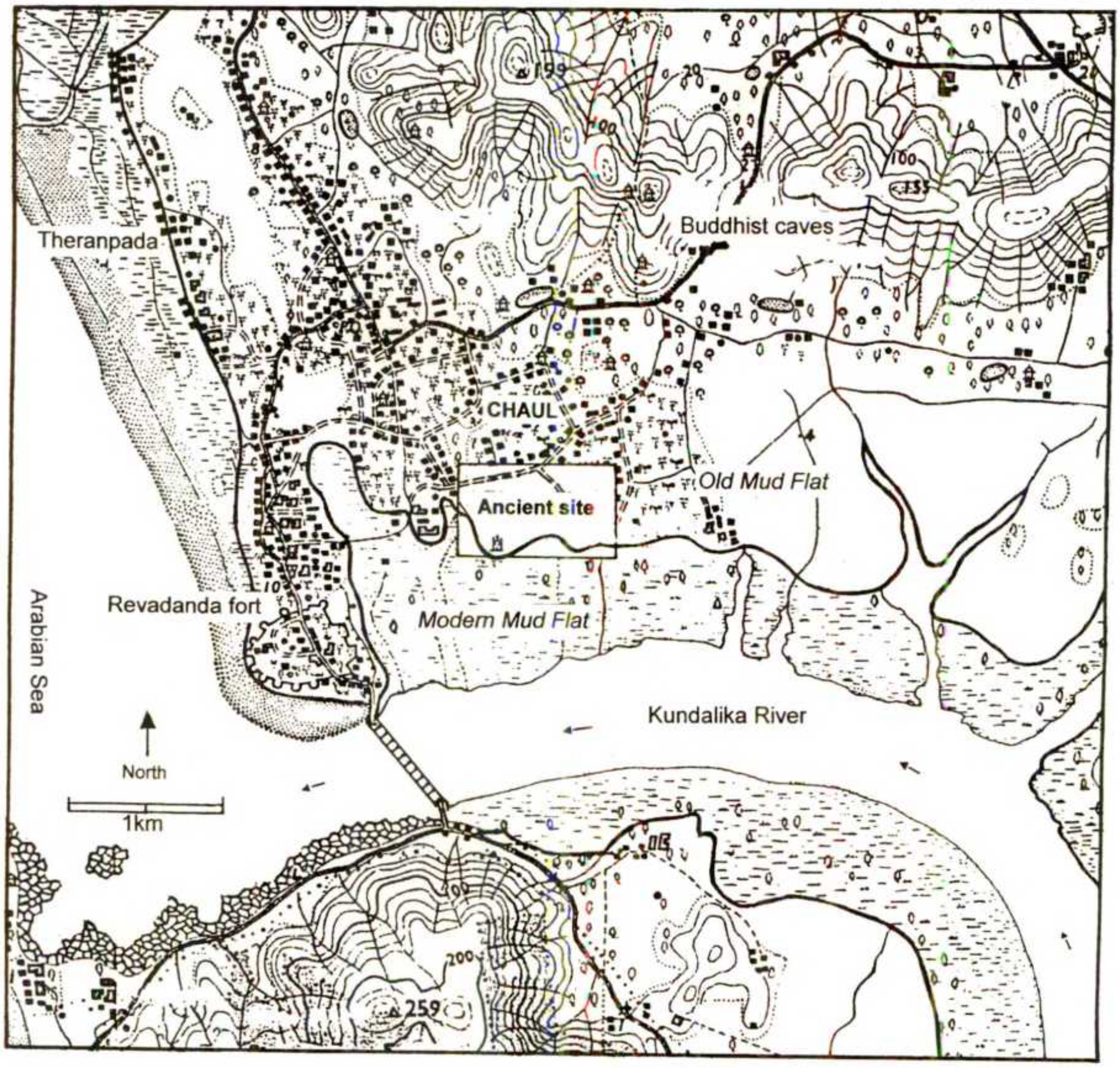


Fig. 2: Map of Chaul showing the area of the ancient habitation

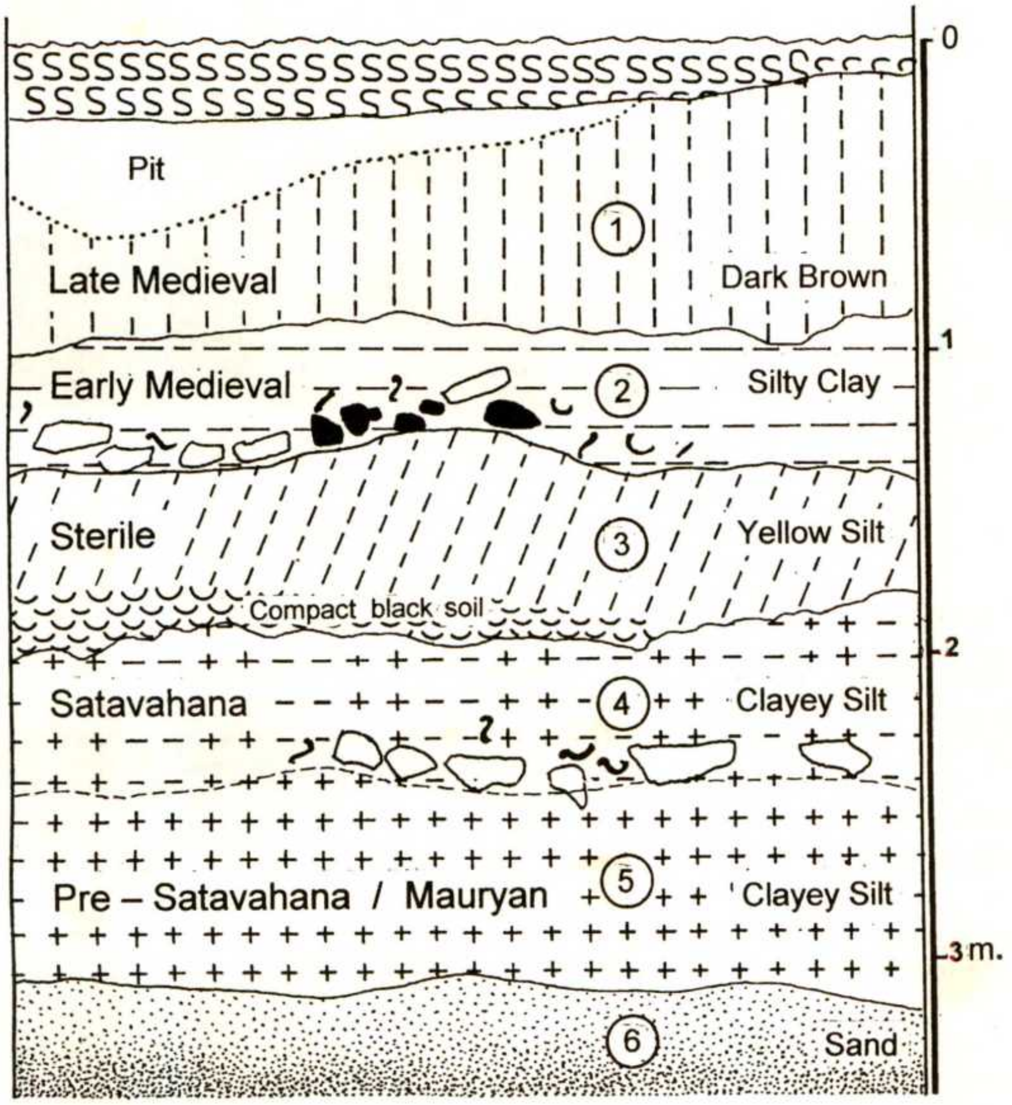


Fig. 3: Statigraphical sequence at Chaul

evidence of the Satavahana period (230 B.C.-230 A.D.) in the form of pottery, ring-wells, coins, saddle querns, glass beads and bangles. The later periods are represented by the presence of archaeological material of the Silahara (c. 1000-1200 A.D.) and the Bahmani (c.1400-1600 A.D.) periods. Most of the evidence came from three wells that were being dug in coconut plantations. Wells in this region are normally dug in the summer by excavating them in a square pattern of about 4 x 4 m till the water level is reached. Unlike several places along the Konkan coast, sweet water is plentifully available at Chaul in the underground hardened sand deposits, locally known as *Kara* or *Karal*. One of the wells gave a sequence of the habitation of the Satavahana and the later periods (Fig. 3).

Stratigraphically, the habitational deposits at Chaul are similar to those at Kolhapur (Sankalia and Dikshit 1952). The post-Satavahana deposits at Kolhapur are classified as the Late-Satavahana (c. 500-1400 A.D.) and the Bahmani (c. 1400-1600 A.D.). The Bahmani period at Kolhapur roughly matches with the Muslim-Maratha period at the ancient sites at Nasik and Nevasa (Sankalia and Deo 1955; Sankalia *et al.* 1960). In order to bring uniformity, the following nomenclatures would be used, henceforth:

a) the Early Medieval period (500-1300 A.D.) variously called as the Late- Satavahana, the Post- Satavahana, and the Silahara periods and,

b) the Late Medieval period (1300-1700 A.D.) which would include the Bahmani and the Muslim-Maratha periods of various sites.

In fact, the general nomenclature of the Early Historic period (250 B.C.-500 A.D.), used elsewhere in India, could have been used for the Satavahana period at Chaul but as many features of cultural material are characteristic of the Satavahana period in western India, the same has been used to describe this part of the Early Historic period.

Archaeological material such as pottery, bricks and saddle querns of different periods could be picked up from the sections of the square well. The sequence from the top to the bottom (Fig. 3) is as follows:

1. Late Medieval period: (0-88 cm) Dark brown clayey deposit. Occurrence: Chinese and the Islamic pottery, iron slag and quern with square platform,
2. Early Medieval period: (88-165) Silty-clayey deposit. Occurrence: the Silahara pottery, small saddle quern with legs,
3. Sterile Layer: (165-187 cm): Yellow silt deposit. Most probably deposited by a flood of the Kundalika river. No archaeological material,
4. Satavahana Period (187-238 cm) Clayey silt deposit. Occurrence: Satavahana pottery, bricks, rig-well, saddle quern with legs, human skull and Roman amphora. The floor was made up of irregular stones followed by the typical large bricks of the Satavahana period,
5. Pre-Satavahana/Mauryan Period: (238-315 cm) Clayey silt deposit. Occurrence: Bright red thin pottery, mineralogically similar to the clays of the Ganga Plain,
6. Sand Layers: (below 315 cm). No archaeological material.

The archaeological material is spread all over an area of about 900 x 150 m in the east-west direction on the southern end of the ancient mud flat, along the present course of the river. The most ubiquitous occurrence on the surface is the Chinese and Islamic glazed wares. The complete sequence of the material of the Satavahana and the later periods were found at six locations during digging of wells. They are widely separated from each other. It, therefore, appears that the Satavahana habitation was not localized in a small area but spread over on a strip of land all along the edges of the ancient mud flat of nearly 1 km in length.

Remains of what could have been an embankment wall or port wall of about 1 m width are observed along the edges of the ancient mud flat (Fig. 4). The length of the wall is nearly 350 m. It is, now, one km away from the present course of the Kundalika river. It is made up of mostly flat stones of irregular sizes apparently without any cementing material. The stones on the riverside are highly weathered. At one place, a sloping stone structure perpendicular to the wall is seen going down towards the river. It disappears into the mud after about 20 m. It is nearly 3 m in breadth and made up of big boulders of basalt. The structure appears to be the remains of an ancient jetty or a wharf.

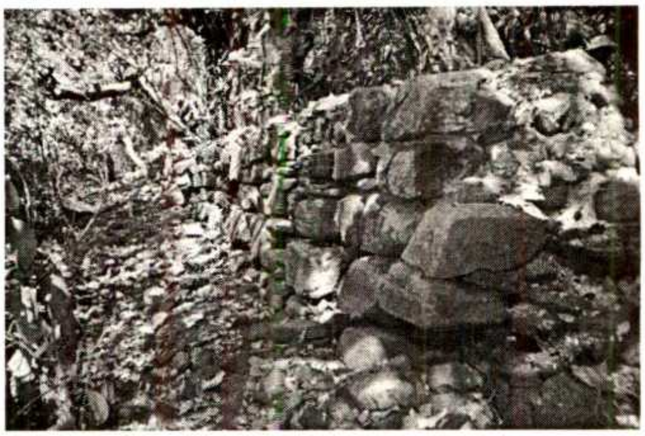


Fig. 4: Embankment and/or port wall along the edges of the ancient mud flat

Interestingly, a broken human skull was collected from the Satavahana layer in the well. It was found along with a body sherd of a Roman amphora, the base of the typical drinking cup of the Satavahana period and a few other indistinct potsherds.

Ceramics

1. *Drinking cups of the Satavahana period*

The cups with sloping sides have a number of wheel corrugations and end with a narrow base (Fig. 5). The fabric is a coarse red ware and has a crude finish. Three varieties of cups are found at Chaul: a) 18.0 cm in diameter at the rim, 4.5 cm at the base with 8.0 cm in height, b) 12.0 cm in diameter at the rim, 5.8 cm at the base with 8.0 cm in height, and c) 12.0 cm in diameter at the rim, 4.0 cm at the base and 4.5 cm in height. The first variety of drinking cups occurs at all known sites of the Satavahana period in the western India.

Early Medieval lid of a pot

It has a high blunt knob-like top with sloping sides and an incurved rim (Fig. 5). This red ware without slip has a

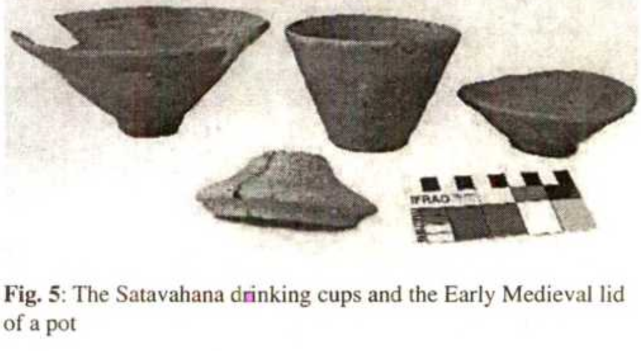


Fig. 5: The Satavahana drinking cups and the Early Medieval lid of a pot

coarse fabric. It is 10.0 cm in diameter with the height of 4.0 cm.

Bright red pottery

A body sherd of bright red thin pottery with a fine red slip is found below the Satavahana layer. It thus, belonged to the pre-Satavahana/Mauryan period. The fine textured pottery mineralogically matches with the pottery and clays of the Ganga Plain (Gogte 1997). This pottery must have been brought either by traders or the Buddhist monks coming from north India. It is pertinent to be mentioned that a Buddhist cave complex is located in a low mountain range in the northeast direction, just 2 km from the site.

Roman amphora

A body sherd of a Roman amphora, found along with a human skull in the Satavahana layer, has a dull red (Munsell Chart: 5YR pink 7/4) body without any inclusions. It has a yellowish white wash on the outer surface and wheel corrugations on the inner surface. It is 0.9 cm thick with a compact body.

Glazed pottery

A large variety of the Chinese and the Islamic glazed pottery is found extensively scattered all over the area (Fig. 6). The Chinese glazed pottery mostly belonged to the Ming Dynasty (c. 1400 B.C.). It occurs in a variety of shades of green, blue, yellow and brown glazes. Porcelain also occurs profusely with fine decorations in dark blue colour. Celadon ware is found with fine olive green glazes occasionally with floral designs in slightly darker shade of green. A beautiful glazed sherd in shades of green, yellow and red with incised floral designs is technologically similar to a characteristic Islamic pottery of the Mamluk period (1250-1516 A.D.) (Bienkowski 1996: 85). It is, however, difficult in some cases to classify the glazed pottery into the Islamic and the Chinese.

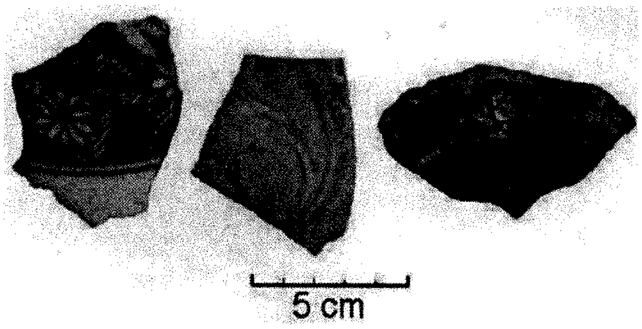


Fig. 6: The Glazed Wares (from left to right): the Chinese Porcelain, the Celadon Ware with floral designs and the Islamic pottery of the Mamluk period

Ring-wells

Numerous broken portions of ring wells are found at Chaul. The average height of a ring is 15.0 cm having 3.0 cm thickness. It has a 6.0 cm thick square rim. The total height of a ring well at Chaul was measured at 2.6 m. Occurrence of ring wells is one of the characteristic features of the Satavahana habitation.

Table 1: The coins found at Chaul[1] (Fig. 7)

Type of coin	Satavahana coin	Maharathi coin*	Bahmani coin
Material	lead	lead	copper
Weight (g)	5.22	5.10	15.35
Diameter (cm)	1.7	1.8	2.2
Thickness (cm)	0.25	0.2	0.5
Obverse	3 Brahmi letters read as SIRI ... are clearly visible.	partially visible and reads as ... MAHAR. The Chaitya is clearly visible.	—
Reverse	Ujjain symbol	the side is indistinct.	—
Comments	assigned to Sri Satakarni (50 B.C.).	the coin is not in a good state of preservation	coin of Sultan Allauddin Ahmad Shah, the son of Ahmad Shah dated to 1436 A.D.

* Maharathis were a powerful people matrimonially related to the Satavahana rulers and were ruling in some parts of the western India (Sankalia and Dikshit 1952: 45-6).

---

[1] These coins were read by Dr. Shobhana Gokhale and Shri Girish Mandke

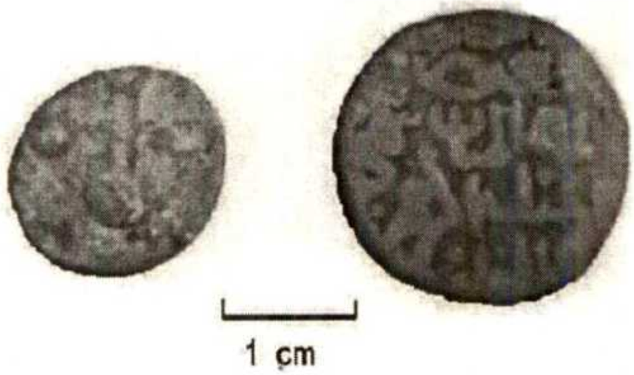


Fig. 7: The coins found at Chaul; coin of Sri Satakarni (left) and of Sultan Allauddin Ahmad Shah (right)

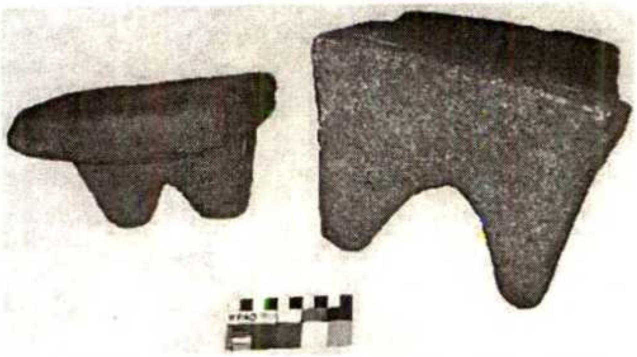


Fig. 8: Two varieties of four-legged saddle querns of the Early Medieval and the Satavahana periods found at Chaul

Coins

Three coins, each of Satavahana, Maharathi and Bahmani, were collected from the square well in the habitational area (Table 1).

Stone objects

1. *Saddle Querns with legs*: Two varieties of four-legged saddle querns made of basalt were found at Chaul. However, both were found in a broken condition (Fig. 8). The dimensions after reconstruction of the first are 48 cm in length, 18.5 cm in height and 20.5 cm in width. The smaller variety has the dimensions of 42 cm in length, 11.5 cm in height and 16.5 cm in width. Querns of similar dimensions were found at Kolhapur, in the Satavahana and the Early Medieval periods, respectively (Sankalia and Dikshit 1952: 130).

2. *Saddle quern without legs*: A broken piece of a saddle quern having a raised square platform at the bottom was found close to the surface. It is 16.5 cm in width and 11.5 cm in height. The length of the broken quern could not be estimated. The width of the platform at the bottom is 18.0 cm with a height of 6.5 cm. It probably belonged to the Late Medieval period though a similar quern was found in the excavations at Paturda (Akola District) in the 8th century archaeological deposit (Dr. B.C.Deotare, personal communication).

Glass

Several small pieces of glass bangles and beads are recovered from the surface of the ancient habitational area at Chaul. Small lumps of glass indicating some kind of glass working activity were also collected.

1. *Trade wind beads*: Small rounded opaque to semi-translucent beads of the average 5.0 mm diameter are in the following colours: black, dark blue, light blue, greenish blue, green, yellow and copper red. The tiniest bead is 2.0 mm in diameter. These beads were made in India and exported, beginning in 200 B.C. and continuing up to the seventeenth century. They are labelled 'trade wind beads' because they are found in archaeological sites by the Indian Ocean in East and South Africa. They are believed to have arrived there in the ships of Arab, Indian and Chinese traders, who sailed with the monsoon winds and ocean currents (Dubin 1995: 184). Glass beads were also produced at Chaul and exported to Africa during the Late Medieval period (Maharashtra State Gazetteers 1964: 726). The lumps of glass and glass debitage found close to the surface at Chaul probably belonged to the glass bead manufacturing of this period.

2. *Melon bead*: The melon shaped dark blue bead has ridges along the length. The half broken bead is 1.1 cm in length and 1.2 cm diameter. This type of bead was commonly found in the Satavahana period at Kolhapur, Chandravalli, Kondapur and Karad (Sankalia and Dikshit 1952: 102) and Arikamedu (Wheeler *et al*. 1946: plate XXXIII; Stern 1991: 119)

3. *Dark blue bangle*: This type of semi-rounded bangles are reported in the Early Historic period deposit at Nevasa.

4. *Polychrome bangles*: One piece of a flat bangle has yellow and orange layers in grooves and beaded circumference. Another piece of a thin translucent bangle has two layers, the upper greenish and the lower yellowish white. Both types commonly occur in the Late Medieval period at Kolhapur.

Iron Slag

A few pieces of iron slag were found scattered on the surface. One of the pieces was found fused with the Chinese porcelain. Thus, the iron working activity at Chaul could be attributed to the Late Medieval period.

Human Skull found in the Satavahana layer[2]

The neurocranial elements recovered from the site of Chaul represent an adult individual (Fig. 9). The skeletal elements

---

[2] Preliminary observations by Drs. S.R. Walimbe and Veena Mushrif

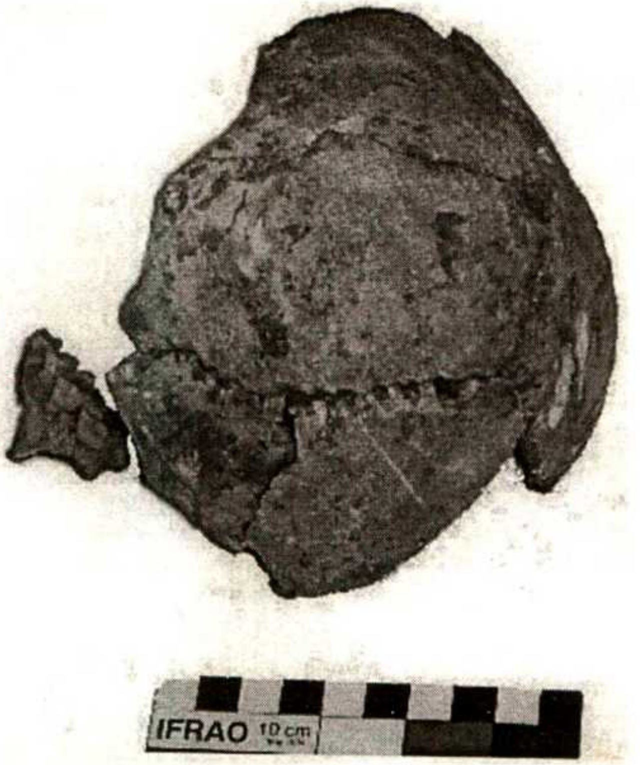


Fig. 9: Human skull found in the Satavahana layer

are in fairly good state of preservation. The amount of weathering is minimal, and some of the cracks are fresh. The inventory includes almost complete occipital, posterior part of right and left parietal, fragment of left temporal bone, and right and left mastoid processes. Besides these elements which could be articulated, ten small-sized fragments of the neurocranial vault are represented in the collection.

The only bone preserved from the facial region is a right maxillary fragment, which retains four teeth in situ, which include Pm1, Pm2, M1 and M2. No bone of the post-cranial skeleton is present in the collection.

Morphologically the bones are robust. Slight amount of porosity is evident in the parietal and occipital region, probably resulting from some non-specific infection. All the four teeth preserved exhibit moderate attrition on their occlusal surface. The attrition grading is 7, 6, and 6, for Pm1, Pm2, and M1, respectively. The wear pattern on the second molar, M2, is uneven. The distal surface of this tooth (hypocone) is almost completely worn out (grade 9), while the mesio-buccal surface is only moderately worn, which can be graded as '5'.

The status of cranial sutures and the attrition status indicates an age of more than 35 years at the time of death. The robusticity expressed in the nuchal area can be graded as '4', and that of the mastoid region as of grade '5', according to the Buikstra-Ubelaker standard (1994), which strongly indicates male sex of the specimen.

East African Contacts with Chaul

The coastal sites in Western India and the East Africa were the components of a large network of ancient maritime trade of the Indian Ocean as evident from the travel accounts written around the beginning of the Christian era by Pliny, Ptolemy, Strabo and the *Periplus of the Erythraean Sea*. Though the archaeological material from the East African sites is yet to be identified at Chaul, indirect evidence is available in the form of the tropical endemic East African tree, *Bao Bab* (Monkey Bread tree-*Adasonia digital L.*). In Maharashtra, it is known as *Ghorakh Chinch*. It was supposed to have been introduced by Arabs centuries ago. It is a long-lived tree, 1000 years and more (Sahni 1998: 42). A very large *Bao Bab* tree having about 10 m girth has been located at the foothills of the Buddhist caves at Chaul (Fig. 10). The large dimension of the tree suggests that it could be more than 800 years old. Another typical East African tree, known as Bread Fruit tree (*Artocarpus communis*) is commonly seen at Chaul. Further explorations and excavations at Chaul

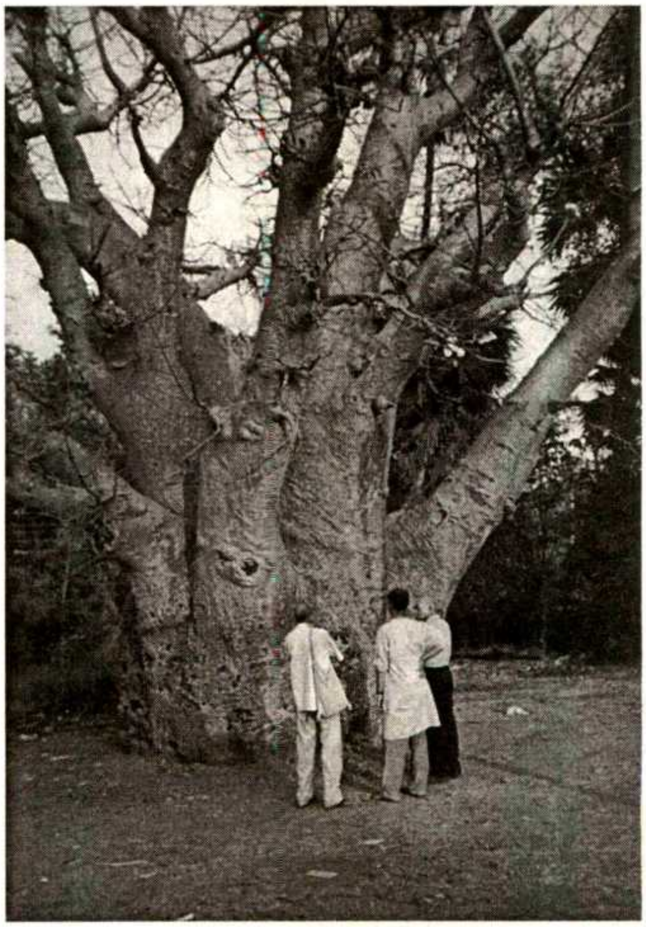


Fig. 10: An ancient East African tree, *Bao Bab*, located at the foothills of the Buddhist caves at Chaul

supported by such indirect evidence would help in reconstructing the trade and cultural interaction between the ancient India and the East Africa.

Conclusion

The explorations at Chaul have given all the salient features of the Satavahana habitation. In contrast, scanty archaeological material is available from the later periods, particularly, of the Early Medieval period. The occurrence of the fine red pottery from the north India below the Satavahana layer suggests the pre-Satavahana/ Mauryan occupation at Chaul. The archaeological evidence at Chaul in many respects is similar to that at Kolhapur. Though the explorations have given ample evidence of the ancient habitation, a large area of Chaul is yet to be surveyed. Further survey and systematic excavations at Chaul would provide a unique opportunity to understand the dynamics of the ancient maritime trade on the west coast of India. It will also be instructive to compare Chaul with the well excavated coastal port site at Tissamaharama in Sri Lanka (Weisshaar *et al.* 2001) as both sites having unique locations, Chaul being at the centre of the west coast of India and Tissamaharama at the southern-most tip of Sri Lanka, must have played a major role in the ancient maritime trade in the Indian Ocean.

Acknowledgements

Enthusiastic support of Dr. P.S. Joshi and Shrikant Pradhan in exploring a wide area at Chaul is greatly appreciated. Section drawings were prepared by Shrikant Pradhan. A visit of Prof. S.N. Rajaguru and Dr.B.C. Deotare to Chaul helped in understanding the geomorphology of the region. Dr. Deotare meticulously recovered the human skull. Dr. S.R. Walimbe and Dr. Veena Mushrif painstakingly reconstructed the broken human skull and provided expert analysis. Thanks are due to Dr. Shobhana Gokhale and Girish Mandke for reading the coins. Without the active help of Anantrao Patil, Sudhakar Raut and Narayan Gharat, all residents of Chaul, the explorations in their coconut plantations could not have been successful. Rajabhau Railkar known as *Vruksha Mitra* in the Konkan showed us the trees from the East Africa and provided useful information on the flora at Chaul.

References

Bienkowski, P. 1996. *Treasures from an Ancient Land: the Art of Jordan.* Gloucestershire: Alan Sutton Publishing.

Buikstra, J.E and D.H. Ubelaker 1994. *Standards: For Data Collection from Human Skeletal Remains,* Arkansas Archaeological Survey Research Series No. 44. Arkansas: Arkansas Archaeological Survey.

Dubin, L.S. 1995. *The History of Beads.* London: Thames and Hudson.

Gazetteer of the Bombay Presidency 1882*: Thana,* Vol. XIV. Bombay: Government Central Press.

Ghate, S. 1990. Palaeogeography of Chaul: a Coastal Town on North Konkan Coast, *Bulletin of the Deccan College Post-Graduate and Research Institute* 49: 145-48.

Gogte, V.D. 1997. The Chandraketugarh-Tamluk Region of Bengal: Source of the Early Historic Rouletted Ware from India and Southeast Asia, *Man and Environment* XXII(1): 69-85.

Huntingford, G.W.B. 1980. *The Periplus of the Erythraean Sea.* London: The Hakluyt Society.

Maharashtra State Gazetteers 1964. *Kolaba District.* Bombay: Directorate of Printing and Stationery, Maharashtra State.

Sahni, K.C. 1998. *The book of Indian Trees,* Bombay Natural History Society. Delhi: Oxford University Press.

Sankalia, H.D. and M.G. Dikshit 1952. *Excavations at Brahmapuri (Kolhapur) 1945-46.* Pune: Deccan College.

Sankalia, H.D. and S.B. Deo 1955. *Report on the Excavations at Nasik and Jorwe 1950-51.* Pune: Deccan College.

Sankalia, H.D., S.B. Deo, Z.D. Ansari and S. Ehrhardt 1960. *From History to Pre-History at Nevasa (1954-56).* Pune: Deccan College.

Sastri, S. M. 1927. *McCrindle's Ancient India as Described by Ptolemy.* Calcutta: Chuckervertty, Chatterjee and Co. Ltd.

Schoff, W.H. 1912. *The Periplus of the Erythraean Sea.* New York: Longmans, Green and Co.

Stern, E.M. 1991. Early Roman Export Glass in India, in *Rome and India: the Ancient Sea Trade* (V. Begley and R.D. De Puma Eds.), pp. 157-196. Madison: The University of Wisconsin Press.

Warmington, E.H. 1974. *The Commerce Between the Roman Empire and India.* Delhi: Vikas Publishing House.

Weisshaar, H.J., H. Roth and W. Vijeyapala 2001. *Ancient Ruhuna* (Vol.1), Sri Lankan-German Archaeological Project in the Southern Province. Mainz: Verlag Philipp von Zabern.

Wheeler, R.E.M., A. Ghosh, and Krishna Deva 1946. Arikamedu: an Indo-Roman Trading Station on the East Coast of India, *Ancient India* 2: 17-124.

Cultural Aspects of the living Megalithic Tradition in Narainpur, Bastar District, Chhattisgarh: A Case Study of the Associated Ceremonies

Arun Kumar and S.N. Bajpai

Department of Anthropology
Ravi Shankar University
Raipur 492 010

Abstract

The paper deals with cultural aspects of the rituals related to living megalithic tradition in the Bastar district (Chhattisgarh). The rituals involve a series of ceremonies, locally named *Guta Urasna, Kalk Urasna and Kalk Hurna. Akomamas* have a definite role to play in these ceremonies. Variations in sex, age and social status as represented in living megalithic traditions are studied. The superstitions and beliefs associated with the traditions are also observed. The underlying belief behind the building of a monument is to provide a permanent resting place for the departed soul.

Introduction

The Megalithic culture flourished in north, central and South India from 1100 to 100 B.C. (McIntosh 1985: 469). Right from its discovery by Babington (1823) at *Bangala Motta Paramba* in Kerala, a number of studies have been carried out to throw light on various facets of the Megalithic culture, namely, its chronology, typology, technology, socio-economy and so on (Mitra 1921; Childe 1948; Ramachandran 1962; Gururaja Rao 1972; Soundara Rajan 1982; Deo 1985; Moorti 1989; Darsana 1998; Sharma 2000; Mohanty and Selvakumar 2002). However, most of our understanding of the Megalithic cultures centers around the burial practices of the period, to the scarcity of habitational sites. Besides, the nature of archaeological records available at Megalithic sites does not present a holistic picture of the burial practices of that period. Very little information is available on the source of large stones, devices used for their transportation, manpower involved, associated rituals and ceremonies, belief systems and role of relatives in creating these monuments during the Megalithic period. In such a situation, the existence of a living megalithic tradition among a few tribal populations in central, eastern and northeastern India assumes a great significance in our proper understanding of the culture. Living megalithic practices provide ethnographic parallels against which archaeological records of Megalithic culture can be better appreciated. The study of living megalithic practices can fill in the gap to a great extent as it could provide clues not only to cultural aspects of the society during the Megalithic period but also to the prevailing belief systems. A number of scholars have enriched our understanding of the various aspects of the living megalithic traditions as practiced among Nagas, Khasis, Kurubas, Bondos, Savaras, and Gond tribes (Hutton 1922; Grigson 1938; Furer-Heimendorf 1943; Elwin 1945, 1947, 1950; Das 1957; Singh 1978; Bareh 1981; Kapp 1985; Cecil-Mawlong 1990; Rao 1991;Rami-Reddy 1992; Devi 1993, 1998; Jamir 1997-1998; Sarkar, 1998; Cooper 1999).

In the Bastar four sub-groups of the Gond tribe, namely, Hill Maria, Bison-Horn Maria, Muria Gonds and Dhorla Gonds erect memorial stones in honour of their ancestors. It is the last ritual to be performed after death. It is performed through an elaborate set of ceremonies, locally known as *Guta-Urasna*, *Kalk-Urasna* and *Kalk-Hurna*. Through this ritual, a permanent resting place is provided for departed souls.

A case study of the ceremony performed to erect 86 memorial stones in the Palki village (81° 13'40" N; 19° 44' 20"E), located 3 km northwest of Narainpur, is presented here. It was performed by twenty-five *Muria* families belonging to *Dugga*, *Usandi* and *Kowachi* clans in memory of the corresponding number of deaths that had occurred during the preceding 20 years or so, since the time the last ceremony had taken place. The ceremonies were spread over five days. Some families had come to participate in the ceremonies all the way from Gatepal, district Chandrapur in Maharashtra, where their ancestors had migrated in the recent past.

Ceremonies Performed

Guta-Urasna

It consists of the fixing of wooden posts (Fig. 1) made of the *Saja* tree (*Terminalia tomentosa*, W. and A.) of

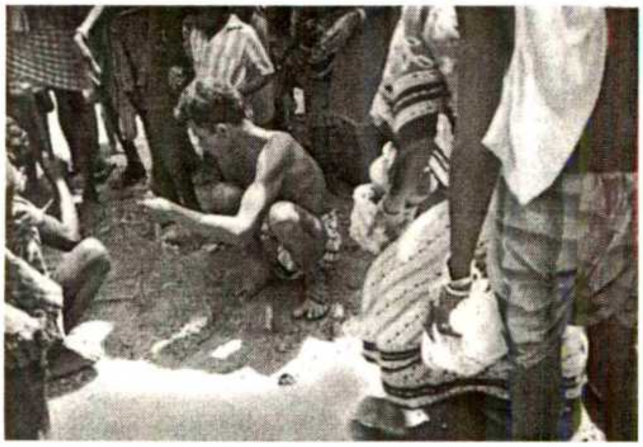


Fig. 1: *Guta Urasna*: fixing of wooden posts in straight line, according to the hierchial status of the deceased person' clan

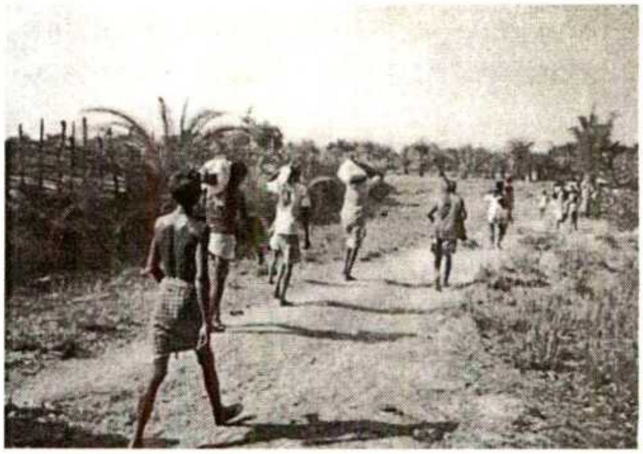


Fig. 3: *Akomamas* carrying memorial stones from the rock exposures, located within the village boundary, to the *marma-kal*

approximately of 30 cm height in the earth, adjacent to *Marma-Kal*, a site specified for erecting memorial stones. Their number corresponds to the memorial stones to be fixed, subsequently. They were fixed in a straight line. Wooden posts representing the *Dugga* clan were the first to be fixed followed by those of *Usandi* and *Kowachi* clans, in conformity with their hiearchial status in the village.

Kalk-Urasna

This is the principal ceremony during which upright memorial stones are erected (Fig. 2). It can be performed at any mutually convenient date. The economic condition of the families involved, agricultural yield of the particular year and the number of deaths that have occurred since the earlier *Kalk-Urasna* are some of the factors considered in finalizing the dates of the ceremony. Memorial stones were brought from rocky outcrops, exposed just a km. away from the *Marma-Kal* within the village boundary (Fig. 3).

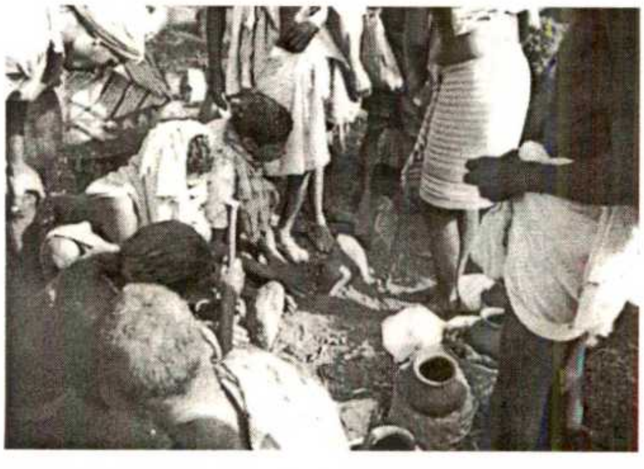


Fig. 2: *Kalk Urasna*: fixing of a memorial stone (menhir)

Many of them were selected from the surface while others were dug out of the earth with iron crowbars. The selected stones did not show any preference for any specific shape. The majority of them were amorphous in shape, while the others were relatively flat. All of them were shorter than 60 cm in height. They were not either shaped or decorated with any art. Male members of the *akomamas* (members of a different clan with whom the participating families have matrimonial relations) transported them on their shoulders individually to the *Marma-Kal.* In occasional cases, a person carried more than one stone. The *Marma-Kal* has no relationship with the burial site. It has well marked areas for various clans. New memorial stones were erected clan-wise in eastward direction in continuation of the pre-existing rows. In the process, spirits of ancestors are grouped together as if they were living in one extending family. The order of fixing new memorial stones was determined by the sequence in which the deaths had taken place.

Separate stones were erected for each deceased person, except for infants. In the case of the infants, a small stone was kept inside the pit dug for fixing the memorial stone of their close relative. No sex-wise variation was noticed in the fixing of the stones. However, stones representing persons of higher social status, like *Patel* (village head-man) and *Sirha* (traditional medicinal man) were given a special treatment. The tail of the sacrificed bullock was tied on the upper portion of their memorial stones.

Kalk-Hurna

This ceremony involves setting up of a mock market for departed spirit on the day following the *Kalk-Urasna*. First of all, the area chosen for the market was purified by taking auspicious fire around it in a procession. The fire is made on paddy grass tied to an iron spear. In the market, clothes, utensils and food items, namely *akki,* flat bread (*Triticum aestivum*), *lie*, a preparation of rice (*Oryza sativa*), roots, tubers, etc were sold by women of the host families as well as of the *akomamas* under false names and at imaginary rates. Male members of the *akomamas*, playing the role of departed spirits, made purchases. A cloth piece, mud piece or leaf was used in place of currency. The ceremony provided some joy and fun, which helped in diluting the gloomy atmosphere of the occasion. Throwing dust on one another was a common sight. The ceremony concluded with the drinking of *mahua (Bassia latifolia*, Roxb.) liquor.

Visiting the Marma-Kal

Close relatives and *akomamas* visited the site on the third day of *Kalk-Urasna*. It was to ascertain if the new memorial stones were standing upright. Falling of a stone within three days of its fixing is considered as a bad omen. It is believed that *Nar-Dumma* a village deity has not accepted the particular spirit, possibly due to certain lapses in performing the rituals.

Rituals Associated with the Ceremonies

Rituals associated with the various ceremonies were identical to those performed at the time of death. The chosen memorial stone, wrapped in a new white cloth, was practically treated as a corpse. *Mahua* liquor was sprinkled on it to make it auspicious. Women cried loudly while hugging the selected stones as if they were the actual corpses. *Mahua* liquor and flowers, branches of *Saja* trees, turmeric water, paddy, rice, *akki, lai*, corns and mutton were the items used in performing the associated rituals. The equipment comprised axe, pickaxe, crow-bar and spear.

Two packets of cooked rice, *mahua* flowers and one iron ring were placed in each pit before fixing the stone in it. Coins were also placed in the pits. However, they were not buried since they were taken away by the *akomamas*.

Community feast

As many as eight feasts, spread over four days, were arranged. All the inhabitants of the village, *akomama* families and *patels* of the neighbouring villages were invited to these feasts. The 25 host families pooled their resources by contributing 35 kg rice and 1.5 kg pulse per deceased person towards the feasts. Besides, they contributed one bullock each for sacrificing (Fig. 4). The materials were deposited with the *bhandari* (store- keeper) of the village for supervision.

Hana-Pata

It comprised of the singing of death songs, which went on uninterrupted throughout the ceremonies. Professional female singers, hired for the purpose, sang these songs. Women members of the *akomamas* and elderly women of the village also joined them in the singing. The singers were paid in the form of clothes, hens, pulse, rice and liquor.

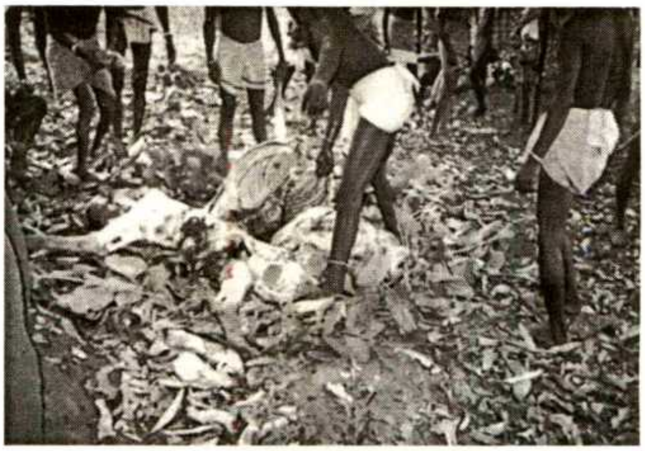


Fig. 4: Sacrifice of a Bullock for the community feast

Role of the *Akomamas*

Practically all the rituals were performed by the *akomamas*, right from the selection of the memorial stones, their transportation and finally to their fixing in the earth. It is either wife's eldest brother or sister's son who performs the ritual. They were treated as privileged guests throughout the function. Special food was cooked for them at home. On the conclusion of the function, belongings of the deceased persons, namely, utensils (glass, *lota*, plate), iron implements (axe, crow-bars, sickle), baskets, fish traps etc. were presented to *Akomamas* as gifts. Occasionally, mango (*Mangifera indica*, Linn.) and sulphi (*Caryota urens*, linn.) trees are also gifted.

Beliefs Associated with Memorial Stones

The underlying belief related to the fixing of a memorial stone is that the soul remains alive after death. It wanders around and inflicts sufferings on members of the family and their belongings. Unless it is provided a place to stay in, it continues to harm the immediate family members. Fixing of a memorial stone is believed as good as making of a permanent house for the departed soul. Once the soul has a place to stay, it is believed to be satisfied.

The fixing of a wooden post symbolizes building of a temporary house for the departed soul. It's subsequent uprooting is done in the belief that the spirit does not require to live in a temporary house any more, as permanent house is being built.

Another belief is that a soul grows and dies like a living person. It is strongly believed that a memorial stone grows in size, which is taken as a proof for the growing of a soul. Similarly, the falling of a memorial stone is considered to imply the death of the soul.

Possible Bearing on the Megalithic Culture

Megalithic sites in the archaeological context are mostly burial-cum-memorial sites; associated with rich grave goods, goods such as iron tools, copper objects, ornaments, animal bones and pottery. There is a possibility that with passage of time, burial and memorial stone erecting ceremonies became separate. Since the living megalithic tradition in the study area is largely concerned with the memory of the departed persons and ancestor worship, it accounts for the lack of grave goods in it. However, survival of the tradition of placing one iron ring and two packets of cooked rice inside the pit, provides a link between the two traditions. Similarly, the practice of sacrificing bullocks and goats on the occasion also represents a survival of the past tradition; the difference being that the sacrificed animal does not form a component of grave goods but is meant for the community feast.

The *Marma-Kal* site of the living megalithic tradition represents memorial stones of various successive generations, implying that its number is not related to population size of the village at any particular time. The observation that a new memorial stone is fixed at one's native village and not at the place where death occurs, needs to be considered while interpreting the archaeological megalithic record. In the living megalithic tradition, an alignment represents memorial stones of a particular clan. The presence of alignments during archaeological Megalithic culture may thus represent clan-wise division of the society during that period, as well.

Thus, knowledge of the living megalithic traditions is essential in unfolding the past Megalithic records. Besides, it enables us to trace back the antiquity of the living megalithic tradition. However, a systematic and comparative study of the living megalithic traditions, as they exist in the entire tribal belt stretching from Bastar to northeast India through Orissa and Andhra Pradesh, is necessary for establishing their exact relationship with the archaeological Megalithic culture.

References

Babington, J.1823. Description of the Pandoo Coolies in Malabar, *Transactions of the Literary Society of Bombay* III.

Bareh, A. 1981. *Megalithic Culture among the Khasis with Special Reference to Mawlong Village*. M. Phil Dissertation. Shillong: North Eastern Hill University.

Cecil-Mawlong 1990. Classification of Khasis Megaliths: a Critique, *Proceeding of North East India History Association, Eleventh Session*, Imphal 9-16.

Childe, V. Gordon 1948. Megaliths, *Ancient India* 4: 5-13.

Cooper, Z. 1999. *Bastar Folk-Art: Shrines, Figurines and Memorials*. Mumbai: Franco-Indian Research Institute.

Darsana, S.B. 1998. Megaliths in the Upper Palar Basin, Tamil Nadu — A New Perspective, *Man and Environment* 23(2): 51-64.

Das, G.N. 1957. The Funerary Monuments of the Niligiris, *Bulletin of the Deccan College Research Institute* 18: 140-158.

Deo, S.B. 1985. The Megaliths: their Culture, Ecology, Economy and Technology, in *Recent Advances in Indian Archaeology* (S.B. Deo and K. Paddayya Eds.), pp. 89-99. Pune: Deccan College.

Devi, B.P. 1993. *Studies on the Megalithic Remains of Manipur*. Ph.D. Dissertation. Guwahati: Gauhati University.

Devi, B.P. 1998. A Study of the Living Megalithic Cultures of the Anals of Manipur, *Man and Environment* 23(2): 119-126.

Elwin, V. 1945. Funerary Customs in Bastar State, *Man in India* 25(2): 87-133.

Elwin, V. 1947. *The Muria and their Ghotul*. Oxford: Oxford University Press.

Elwin, V. 1950. *Bondo High Lander*. London. Oxford University Press.

Furer-Heimendorf, C.Von 1943. Megalithic Rituals among the Gadabas and Bondas of Orrisa, *Journal of Asiatic Society of Bengal Art* 9 (1): 149-178.

Guru Raja Rao, B.K. 1972. *The Megalithic Culture in South India*. Mysore: Prasaranga University of Mysore.

Grigson, W. 1938. *Maria Gonds of Bastar*. Oxford: Oxford University Press.

Hutton, J.H. 1922. The Meaning and Methods of Erection of Monoliths of Naga Tribes, *Journal of Royal Anthropological Institute* 52: 242-249.

Iyer Krishan, L.A. 1938. The Significance of Megalithic Monuments, *Quarterly Journal of Mythic Society* 29: 58-61.

Jamir, Watijungshi 1997-1998. Megaliths in Nagaland, *Puratattva* 28: 104-111.

Kapp, D.B. 1985. The Kurumbas Relationship to the 'Megalithic' Cult of the Nilgiri Hills (South India), *Anthropos* 80: 493-534

McIntosh, J.R. 1985. Dating the South Indian Megaliths, in *South Asian Archaeology* (J. Schotsmans and M.Taddei Eds.) pp. 467-493. Naples: Instituto Universitario Orientale.

Mitra, P. 1921. The Indian Megalithic- Their Origin and Chronology, *Proceedings of Asiatic Society of Bengal* XVII: ccxi.

Mohanty, R.K. and V. Selvakumar 2002. The Archaeology of the Megaliths in India: 1947-1997, in *Archaeology in Retroperspect; Prehistory* I (S. Settar and R. Korisettar Eds.), pp. 313-351. New-Delhi: Munshi Ram Publishers.

Moorti, U.S. 1989. *Megalithic Culture of South India: Socio Economic Perspectives*. Ph.D. Dissertation. Pune: University of Pune.

Ramachandran, K.S. 1962. Some Aspects of the Economy of the Megalithic, *Indian Historical Quarterly* 38(1): 60-64.

Rami Reddy, V. 1992. Megaliths in India-Past and Present, in *New Trends in Indian Art and Archaeology* (B.U. Nayak and N.C. Ghosh Eds.), pp. 37-44. New Delhi: Aditya Prakshan.

Rao, S.N. 1991. Megalithic Practices among the Khasis and Nagas of North-Eastern India, in *Archaeology of North-Eastern India*, (J.P. Singh and Gautam Sengupta Eds.), pp. 106-126. New Delhi: Har-Anand Publications.

Sarkar, A. and S. Banerjee 1998. Urskal- The Megalithic Monuments at Bastar, *Bulletin of Tribal Research Institute* (Bhopal) 26(1): 53-59.

Sharma A.K.2000. *Archaeo-Anthropology of the Chhattisgarh*. New Delhi: Sandeep Prakshan.

Singh, O.K. 1985. A Live Megalithic Culture in Manipur, in *Recent Advances in Indo-Pacific Prehistory* (V.N. Misra and Peter Bellwood Eds.), pp. ???. New Delhi: Oxford and IBH.

Soundara, Rajan, K.V. 1982. Origin and Spread of Memorial Stones in Tamil Nadu, in *Memorial Stones: A Study of their Origin, Significance and Variety* (S. Settar and G.D. Sontheimer Eds.), pp. 59-76. Dharwad and New Delhi: Karnataka University and South Asia Institute of Heidelberg University.

Caves of Western India — An Intranet Website

Ashok Marathe, Viraj Shah, Nivedita Gandhi[1] and Sunil Deshapande[1]

Department of Archaeology
Deccan College
Pune 411 006

1 Sateri Systems, Pune

Abstract

Intranet websites interconnect information and the people who need that specific information. The security system ensures that only identifiable users have an access to the explicit data. The main aim of communicating the data on the caves of Western India on a website is to make people, especially laypersons, aware of the rich cave-tradition of the region and understand these caves from a historical perspective. The information on a website, apart from being accessible to every one, is easy to grasp due to the lucid language used and the systematic presentation of the facts. It highlights the important features with pictures and diagrams to enhance their unique attributes.

Caves of Western India

Rock-cut architecture has a long tradition in India. It was one of the popular modes of architecture for religious structures, other than the structural architecture. From the modest beginning as a small residential cell in imitation of a wooden hut, in the Barbara hill, Bihar, dating back to the 3rd century B.C., it developed into elaborate and complex temples as exemplified at Ellora in Maharashtra. Caves were excavated for all the three major sects of India, i. e. Buddhism, Jainism and Brahmanism. The earliest caves were excavated for the ascetic sects like Ajivika, Buddhism and Jainism mainly as residential cells for the monks, who were required to stay in seclusion and later on also as places of worship. By the Gupta period, caves came to be hewn for Brahmanism too, primarily as places of worship because of the nature of the sect.

Owing to its hilly terrain, Maharashtra contains the largest number of caves in the country. The main Sahyadri mountain range, running North-South, divides the region in two distinct parts — the western coastal strip known as Konkan and the eastern plateau, known as Desh. Originating from the Sahyadri and running west-northwest to east-southeast into the plains are hill ranges of Satmala-Ajanta, the Balaghat and the Mahadev. Rocks of volcanic origin underlie the major part of Maharashtra, basalt or what is known as Deccan Trapp. On the coast of Konkan, several natural caves are known in the close vicinity of the town of Guhagar. Some of these caves, have a perennial water supply in the form of ponds and/or streams, and could have provided ideal settings for occupation by prehistoric humans. The Konkan region, in general, has provided sparse evidence of occupation by the prehistoric people. It is generally thought that the high rainfall in the coastal region would wash away the remains of human occupation. Except the Acheulain cave at Susrondi (Guhagar), Mesolithic occupation in a cave at Hathkhamba (Ratnagiri) and Mesolithic cave at Pachad (Mahad), little authentic evidence of prehistoric occupation has been reported in this area.

However, the hilly characteristics of Western India have provided favourable sites for the artificial caves, which dot the landscape. Here the tradition of rock-cut architecture, which developed from the ancient times survived for a very long period, even when it had almost died out from the other parts of the country. Thus, here it has a continuous tradition starting from the 2nd century B.C. and lasting almost up to the 14th century A.D. During this period of around 1600 years, a large number of caves, belonging to Buddhism, Jainism and Brahmanism were excavated.

Though the caves are scattered in all parts of the state, its concentration is mainly in Western Maharashtra because of the physical attributes of this area, which provides suitable scarps and hill-ranges for the excavation of a cave. The study area, roughly defined as Western Maharashtra, comprises the coastal strip of Konkan and adjoining western districts of Desh area such as Nasik, Pune, Satara and Kolhapur. The maximum number of caves in Western Maharashtra are Buddhist, of which a large number of caves belong to the earlier Hinanyana phase of Buddhism. These caves date from the 2nd century B.C. to around 2nd-3rd centuries A.D. The typical cave of this period is *chaitya* with a *stupa* and a *vihara* — either single residential cells or a hall with cells around it. A *chaitya* is a decorative cave with impressive façade, beautifully executed pillars and elaborate *stupa*. The *viharas* are relatively plain with simple ornamentation above cell doors in some cases and provision of beds in the cells. These caves are architecturally simple and quite plain. All the sites have at least one or more cisterns, which remain filled with water throughout the year. These caves carry a large number of inscriptions recording the donations of these caves, cisterns or some parts of the caves, such as bench, pillar, *stupa*, etc. by the people from all walks of life. Many of these caves, especially those at Nasik received royal patronage from the Satavahana and Western Kshatrapa dynasties.

A number of these Hinayana sites were taken over by the Mahayanists around 4th-5th centuries A.D., who practiced image worship. Thus, the caves of this period have the image of Buddha as an object of worship, though *stupa* also continued to be worshipped and in many instances the icon of Buddha was carved on the *stupa*. The typical cave of this period is a *chaitya-vihara* — hall with residential cells around and a shrine containing the icon of Buddha on the back wall. These caves are elaborate with decorative architectural components and a large number of beautifully sculpted icons. Many of them were profusely painted, of which only traces remain now. There are a few inscriptions recording various donations to the caves, though the number is less as compared to the earlier period. These caves can be dated between the 4th and the 6th century A.D., except at Kanheri and Panhale-Kaji in Konkan, which flourished till about the 10th century A.D.

The Brahmanical caves are few in number. They are architecturally and iconographically different from the Buddhist caves. They are essentially places of worship as per the demands of the sect. All the Brahmanical caves are Shaivite. These caves, especially the cave at Elephanta, exhibit some of the finest and elaborate sculptural panels depicting various scenes associated with Shiva. The Brahmanical caves date to around 6th-7th centuries A.D. The caves at Ankai-Tankai in Nasik district are dated to the 9th century A.D. There are stray examples of late caves, datable to the 11th-12th centuries A.D. in Pune district as exemplified at Bhamachandra near Chakan.

The Jaina caves are the latest. With the exception of a residential cell at Pale in the Pune district, which is datable to the 1st century B.C., the Jaina caves in this region can be dated to the period between the 10th and the 14th century A.D. Except a few, most caves are architecturally very crude, rough and plain excavations. The emphasis is on the icons, which are mainly of *tirthankaras* and *yaksha-yakshi*. Some of the more ornate caves such as those at Ankai-Tankai in Nasik district exhibit a tendency to imitate contemporary structural temple architecture in terms of components like ceiling, pillar, plinth, doorway etc. Thus, the rock-cut architecture, beginning as an imitation of wooden structures and eventually developed its own style and finally reached its culmination as an imitation of structural architecture in stone.

Earlier work

There are only three prehistoric caves that are excavated and studied (Joshi and Bopardikar 1972; Marathe, in press). The study of the caves of historic period dates back to the British period. Most of the sites were recorded in the reports of Western Circle of Archaeological Survey of India. A few articles were published in various journals by scholars like Wilson (1853) and Sinclair (1876). These early attempts were mainly confined to brief description and identification of the sect to which the caves belonged. This stray information was compiled by Fergusson and Burgess (1880) in their monumental work on the caves of India providing detailed documentation, accurate ground plans and line drawings and a number of plates. They also proposed tentative dates and chronology of these caves. A collection of all the inscriptions from the Western Indian caves along with translation and other related information was brought out by Burgess and Indraji (1881). Later on, a number of studies were carried out on the rock-cut caves based on this early documentation. However, the caves of this region particularly were studied by Kosambi (1955, 1961), Dehejia (1972), Jadhav (1980), Nagaraju (1981), Dhavalikar (1984) and Deshpande (1986). Though mainly preoccupied with the Buddhist caves, these studies were carried out from architectural, iconographic, epigraphic and religious perspectives. The architectural development, chronology, intra-site relationships and patronage were some of the broader aspects that were studied. The historical background in which these caves thrived was also given due importance. The relationship between the early Buddhist caves and brisk trade during the Early Historic period was brought to notice by Kosambi (1961). Detailed work by Ray (1986) revealed the role played by these Buddhist caves in the mechanism of the trade with the Western world in the early centuries of the Christian era.

The Brahmanical caves have been studied mainly from architectural and iconographic perspectives (Soundara Rajan 1981; Berkson *et al.* 1983). Compared to the Buddhist and the Brahmanical caves, the Jaina caves are less worked upon. Most of the study is confined to brief reporting (Fergusson and Burgess 1880; Cousens 1931; Sankalia and Gokhale 1969).

In this context a website has been designed on the caves of Western India to bring out the importance of these caves in the cultural heritage of the region. The main aim of surmising the data on these caves on a website is to make people, especially the laypersons, aware of the rich cave-tradition of the region and understand these caves in a historical perspective. The information on a website, apart from being accessible to every one, is easy to grasp as it is explicit and it highlights important features of the caves.

Intranet Website

The Intranet website is accessible only by login. It applies either HTTPS/HTTP to access its web pages. HTTPS is Hyper Text Transfer Protocol with security by password protection. HTTP without security but with password protection is generally used to restrict access to specific documents. Suitably designed intranets, interconnect the information and the people who need that information. The main Intranet applications are in communications, training, human resources, marketing and sales.

An intranet website contains a home page, which is the first document the users see when they enter the site. The home page serves as an index or table of contents to other documents stored at the site. The site might also contain additional documents and files. Each web page is identified by unique URL (Uniform Resource Locator) and each site is managed by an individual or by an organization.

A computer that serves up web pages is a web server and every web server has an IP address and possibly a domain name. Microsoft's Personal Web Server (PWS) is a scaled - down version of the commercial Information Internet Server (IIS) included with the Server edition of Microsoft Windows NT. Designed for Windows 95 and Windows NT Workstation users, PWS is a great entry-level Web Server that makes it easy to publish personal home pages, serve small Web sites, and share documents via a local intranet. One key advantage of using PWS over IIS and similar high-end Web servers is the client's ease of use. PWS is one of the best servers available to help you get up and run quickly (Purcell and Mara 1997). Wizards are included to guide you through the process of setting up home pages and sharing files, and the PWS administrator reduces the complexity of actually running the Web Server itself. You can also use the familiar Explorer interface or PWS's Personal Web Manager to share directories, start and stop the server, and view Web site statistics.

Active Server Pages (ASP) is Microsoft's solution to creating dynamic web pages. With the explosion of the Internet and World Wide Web (WWW) into our everyday lives, Web site creation is quickly becoming one of the fastest growing sectors (Mitchell and Atkinson 2000). Microsoft Windows Platform plan to develop dynamic web site and with database connectivity, then the Active Server Pages will be the simpler choice. ASP includes database connectivity. It has the ability to create dynamic Web site and it is easy to use by those who are familiar with Visual Basic. The following flow-chart shows the plan of the website (Fig. 1).

Western Indian Caves [WIC]

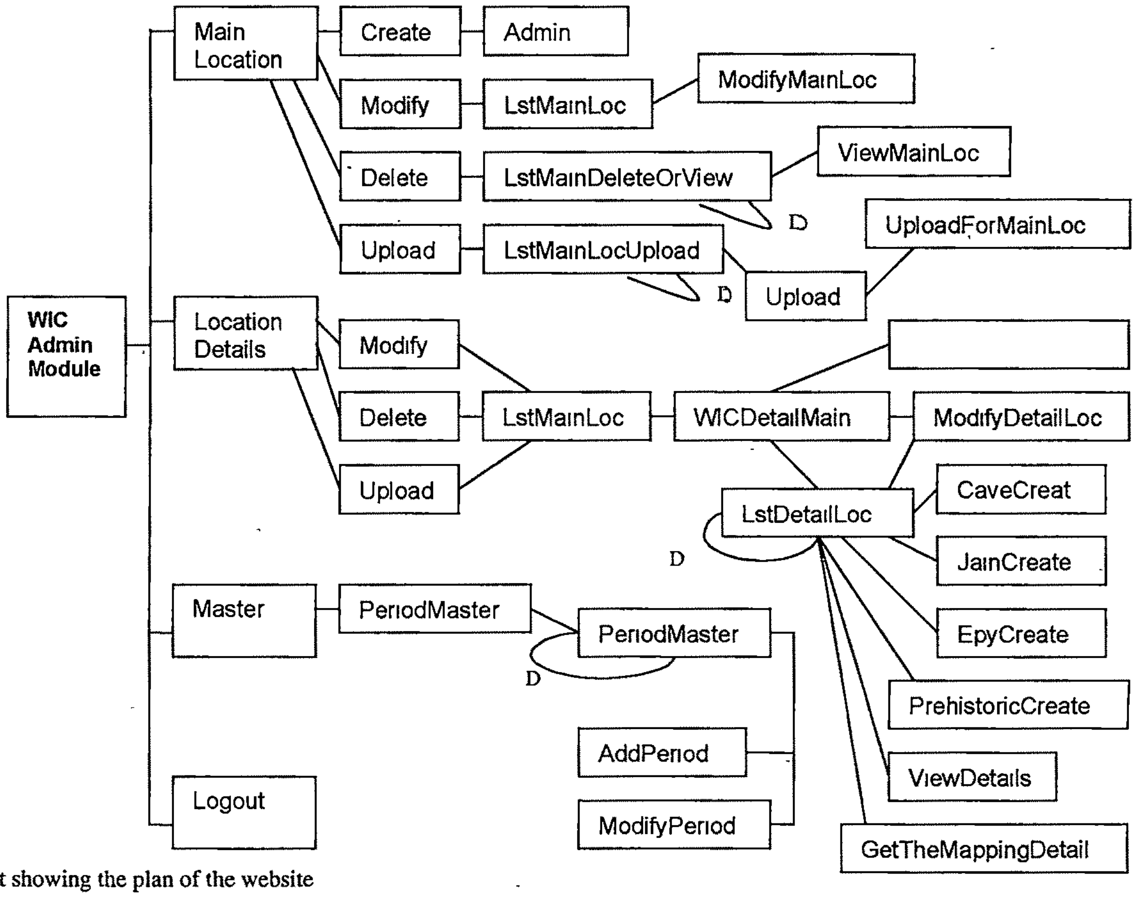


Fig. 1: The flow-chart showing the plan of the website

The present website includes all the information on the Prehistoric, Buddhist, Brahmanical and Jaina caves in Western India. It is divided under three broad headings-location, location details and period. The category of 'location' includes sub-divisions of the study region. As the sub-division of the region is taken to be the present-day district, this category includes a district as a main location. The next heading is the 'location details', which covers all the caves within each district or the main location. The information under this division is further divided into four categories: 1) Buddhist Caves, 2) Brahmanical Caves, 3) Jaina Caves and 4) Prehistoric caves. These categories provide information on the main architectural as well as iconographic features, date and chronological placement of each cave in brief. Information on any archaeological site around the caves, which may have been the contemporary human settlement, sustaining the cave-site, is given wherever possible. The list of inscriptions appearing in each cave provides an insight into the type of patronage that these caves received. The third broad division of the website, 'Period' includes the approximate time-period or date of each of the cave-site. It gives, at a glance, an idea of the broad period within which each cave-site flourished.

Discussion

We have used Microsoft Windows platform and have developed a dynamic website with database connectivity by Active Server Pages. An important aspect of this website is a digitized detailed map pointing at the exact location of each cave, which helps to locate known as well as less known cave-sites accurately. The legends provided on the map makes it easy to locate and differentiate Buddhist, Brahmanical or Jaina cave-site at a glance. All the information about any cave-site or inscription can be viewed by just a click on the map; such as, name, period, distance and detail information. Interface has become very user friendly and interactive.

Thus, with a number of maps and analytical data, this website endeavours to present the rich treasure of western Indian caves in an easy and eloquent manner. It is hoped that this website will be a welcome addition for scholars as well as laypersons.

References

Berkson, Carmel, Wendy Doniger O'Flaherty and George Michell 1983. *Elephanta: The Cave of Shiva.* Princeton: Princeton University Press.

Burgess, J. and Bhagwanlal Indraji 1881. *Inscriptions from the Cave Temples of Western India with Descriptive Notes.* Mumbai: Bombay Government Central Press.

Cousens, H. 1931. *Medieval Temples of the Dakhan.* Archaeological Survey of India, Imperial Series: 48.

Dehejia, Vidya 1972. *Early Buddhist Rock Temples.* London: Thames and Hudson.

Deshpande, M.N. 1986. *The Caves of Panhale-Kaji.* New Delhi: Archaeological Survey of India, MASI: 84.

Dhavalikar, M.K. 1984. *Late Hinayana Caves of Western India.* Pune: Deccan College.

Fergusson, J. and J. Burgess 1880. (1988 reprint) *The Cave Temples of India.* Delhi: Munshiram Manoharlal.

Jadhav, S.V. 1980. *Rock-cut Cave Temples at Junnar: An Integrated Study.* Unpublished Ph. D. Thesis. Pune: University of Poona.

Joshi, R.V. and B.P. Bopardikar 1972. Stone Cultures of Konkan (Coastal Maharashtra), in *Archaeological Congress and Seminar Papers* (S. B. Deo Ed.), pp. 47-57. Nagpur: University of Nagpur

Kosambi, D.D. 1955. Dhenukakata, *Journal of Bombay Branch of Royal Asiatic Society* 30: 50-71.

Kosambi, D.D. 1961. The Buddhist Caves of Western India, *The Times of India, Annual*: 72-82.

Marathe, A.R. (in press). Acheulian Cave at Guhagar, Konkan, Maharashtra, *Current Science.*

Mitchell, S. and J. Atkinson 2000. *Teach Yourself Active Server Pages 3.0.* New Delhi: Techmedia.

Nagaraju, S. 1981. *Buddhist Architecture of Western India (c. 250 B.C.–c. A.D. 300).* Delhi: Agam Kala Prakashan.

Purcell, L. and M.J. Mara 1997. *The ABCs of JavaScript.* SYBEX Inc. USA

Ray, H.P. 1986. *Monastery and Guild.* Delhi: Oxford University Press.

Sankalia, H.D. and Shobhana Gokhale 1969. A Brahmi Inscription from Pale, *Epigraphia Indica* 38: 167-168.

Sinclair, W.F. 1876. Notes on Some Caves in the Karjat taluka of the Thana Collectorate, *Indian Antiquary* 5: 309-310

Soundara Rajan, K.V. 1981. *Cave Temples of the Deccan.* New Delhi: Archaeological Survey of India.

Wilson, J. 1853. Second Memoir on the Cave-temples and Monasteries and other Ancient Buddhist, Brahmanical and Jaina Remains of Western India, *Journal of the Bombay Branch of the Royal Asiatic Society* 4: 340-379.

Book Review

Dilip K. Chakrabarti, 2003. ***Archaeology in the Third World — A History of Indian Archaeology Since 1947.*** **D.K. Printworld (P) Ltd. New Delhi. Pp. 279, Rs. 800/-.**

Dilip K. Chakrabarti has to be thanked for writing this thought provoking book, *Archaeology in the Third World - A History of Indian Archaeology Since 1947.* He teaches South Asian archaeology at Cambridge University for several years now. In this book the author offers an authoritative historical frame of archaeological research in post–independence India, highlighting the major mileposts in its story of development. This is accompanied by an incisive analysis of different aspects of Indian Heritage management, including the impact of religious fundamentalism. As an appendix he also gives a detailed discussion of the scope of 'nationalist archaeology' in India. Chakrabarti has always been very meticulous about his data and research. He is also a very versatile and prolific writer. He publishes a new book — if not two — every year. Despite his settling in UK, he manages to do some fieldwork in India practically every year. An incisive mind and an abrasive pen mark his writings! Though he is settled in UK now, he is very critical of the imperialist attitude of even those archaeologists who are working in South Asia. The reviewer happens to be an old friend and colleague of Chakrabarti, which makes it a bit embarrassing for him to critically review this valuable work, though in this book he has not spared his friend even.

The book raises some basic issues in the last chapter. Chakrabarti admits that both the concepts of 'the archaeology of the past' and also research were imports from the colonial masters. He also thinks that the nationalists in India were quite happy with the text-based reconstruction of the past, where there was no room for archaeology. He laments that archaeology had hardly any place in the education system. He feels sorry that things have not changed much even after Independence. In fact, government regulations controlling archaeological research have only increased. Archaeology is tagged to history departments even today. Chakrabarti complains, "There is hardly any emotive quest for the past in the modern Third World." He also notices that in the Third World there is no concept of rescue archaeology.

Chakrabarti admits, "These may not make pleasant reading, but in the context with which I am personally familiar, I am not likely to take back a single sentence..." This sort of arrogance has become a hallmark of Chakrabarti's writings. As if he has some special access to revealed knowledge. There are no absolute truths in the pursuit of knowledge. Everything is subject to change.

His diagnosis about what ails Indian archaeology seems to be a bit superficial. I have had a long experience of interacting both with archaeologists and scientists as I was running the national radiocarbon dating program. I tried my best to bridge the yawning gulf between archaeologists and scientists, but failed, mainly because the archaeologists never bothered to get acquainted with scientific techniques. I have had no problems in getting full cooperation of archaeobotanists, geologists, physicists and others in my multidisciplinary projects in Rajasthan and Kashmir. If the Radiocarbon Lab at Ahmedabad is no more interested in doing archaeological samples, the fault lies squarely with archaeologists. We had even offered to build radiocarbon labs at Deccan College, Pune and Institute of Archaeology, Delhi, but there were no takers. Following the same ignorant attitude to scientific analyses, Chakrabarti condemns genetic evidence.

Chakrabarti may be partially right in condemning the condescending attitude of foreign archaeologists working in South Asia. But the fault lies equally with the Indian scholars. Very few of them have the aptitude or inclination to learn new techniques. Most of the archaeological excavation reports are in arrears, and I am sure they would never see the light of the day. It is such a colossal waste in a poor country. The Union Minister of Culture now plans to excavate 1500 more sites of 'lost cities' and thus again they will be buried in the godowns of the Archaeological Survey. We don't need new excavations; we need full publication of scores of pending excavation reports — both scientific and popular. If our excavators sit down to report they will at least study to interpret their data. Take the Harappan sites alone, Kalibangan, Rakhigarhi, Ropar, Banawali, Alamgirpur, Dholavira, etc. are all pending.

From whose writings we learn about the sub-continent's archaeology? The Americans publish annual reports of the Harappa Excavations. Kenoyer has published a synthesis of the Harappan material. Gregory Possehl has been writing voluminous books on Indus Civilization. What has happened to Indian scholars? It is this sloth and ignorance that makes Indian and Pakistani archaeologists feel inferior against foreign scholars. I am not denying that the Western nations and scholars perhaps suffer a bit of superiority complex. It is not that they have any extra grey cells; it is only because they can spend more money on excavations and in granting favours to aspiring Indian/Pakistani archaeologists. Today USA got away scot-free after invading poor Iraq, against global opposition, only because it is super-rich and powerful. To fight such arrogance the Third World countries have also to become powerful, publish better books and papers, improve quality of their work and publications. Then the West will be forced to recognize their worth.

We will now have a look at what the author discusses in his various chapters. Basically through critical, sometimes even sweeping, reviews of publications he surveys the progress of Indian archaeology during different periods — both before and after Independence. I don't understand why he calls his book *Archaeology in the Third World.* In fact, he talks mostly of India only, not even of Pakistan. All told, it must be admitted that it is an important work which critically evaluates the progress of Indian archaeology, especially after Independence.

The author has tried to review important publications on Indian archaeology (*Ancient India, Indian Prehistory: 1964, Indian Archaeology a Review*, etc.) in his first chapter, 'The Quest for New Horizons, 1947-73'. Chakrabarti divides each chapter into various time periods for simplicity. He introduces many points with the help of various issues of *Ancient India.* He points out that Mortimer Wheeler emphasized the question of the hiatus between the end of the Indus civilization and the beginning of the early historic cities of the Gaṅga plains. We are also told that Niranjan Prasad Chakrabarti has dealt with the issue of archaeology in the Indian princely states. The changed circumstances of India becoming independent allowed drafting of the new constitution of India in which archaeology was kept as a central subject though it only mentioned ancient and historical monuments, sites and remains of 'National importance'. V.D. Krishnaswami resolved the archaeological problems related to 'Megaliths' in his article. A number of major developments may be said to have taken place during 1954-65.

The author has discussed in detail the *Indian Archaeology — A Review (IAR)*, which was edited by A. Ghosh. IAR is the most important window on archaeological field-activities in modern India and also on the diverse activities of the Archaeological Survey of India. Many sites were excavated during 1953-54 to 1972-73. The author gives a detailed list of these sites in this book.

Chakrabarti discusses some important publications, like B. Subbarao's *The Personality of India* and D.H. Grodon's *Prehistoric Background of Indian Culture, Puratattva* (Bulletin of the Indian Archaeological Society), etc. He also gives a short note in the first chapter on Radiocarbon Dating and a Neglected Blueprint of Archaeological Science. He tries to blame me for not recognizing that it was S.D. Chatterjee who was the pioneer of radiocarbon dating in India. I had a long correspondence with Chatterjee asking him the details of his techniques, as radiocarbon dating is not a simple technique (as it requires advanced ancillary facilities of electronics, workshop, computers, liquid nitrogen, etc.) to be installed in a University set-up. Chatterjee never replied to the queries raised by me. Years later I was informed by the director of the Copenhagen Lab that he had done the samples from Pandu Rajar-dhibi in his lab for which Chaterjee fraudulently took credit. Since Chakarabarti has put the blame at my door, I had to mention this sordid episode, which I had never mentioned before.

In the second chapter 'New Issues and Perspectives, 1974 to the Present' the author highlights some important contributions made by H.D. Sankalia. He gives detailed information about the publication of *Prehistory and Protohistory of India and Pakistan.* The author also throws light on the terms 'Lower Palaeolithic' and 'Middle Palaeolithic'. The most important feature of the second chapter is the description about Radiocarbon Dating in India. Chakrabarti most graciously recognizes the role played by the Tata Institute, Mumbai and Physical Research Lab, Ahmedabad, as also of my colleague Sheela Kusumgar.

The author gives detailed information about *The Rise of civilization in India and Pakistan* written by B. and F.R. Allchin and *The Archaeology of India (1982)* by D.P. Agrawal as two important general books on the subcontinent's prehistory and protohistory. He also discusses some other publications edited by some well-known archaeologists. The excavated sites are listed in the second chapter from IAR 1973-74 to 1989-90. He decries the DNA study of both modern and ancient populations by Bamshad *et al.*

In the next chapter 'Archaeological Heritage Management, Education and Nationalism' Chakrabarti brings up various issues. In this chapter he tries to look at the general history of archaeology in post-Independence India. He says archaeology has failed to grow as an academic subject in India. The Ford Foundation gave financial support in the second half of 1980's to three archaeological programs in the country. When *Man and Environment* got a large amount of money from the Ford Foundation it shifted to the Deccan College, Pune. The responsibility for the conservation and preservation of the 'protected' monuments and sites were with the Archaeological Survey of India. But for the unprotected monuments the responsibility lies with the state departments or directorates of archaeology.

The author describes in detail the preservation of Archaeological Heritage. He says chemical treatment of both structures and antiquities plays a major role in the Survey's schemes. Chakrabarti says that the Indian universities, museums and other institutions played a crucial role in the preservation of archaeological heritage. He describes the various kinds of museums, and different types of Acts related to The Ancient Monuments and Archaeological Sites. The Ancient Monuments Preservation Act of 1904 aimed:

> to provide for the preservation of ancient monuments, for the exercise of control over traffic in antiquities and excavation in certain places and for the protection and acquisition in certain cases of ancient monuments and of objects of archaeological, historical, or artistic interest.

The author discusses the role and contribution of non-governmental agencies also. One of them is the Indian National Trust for Art and Cultural Heritage (INTACH) established in 1984. The consultants at INTACH prepare 'heritage plans' for different areas; the implementation of these plans is not possible without the governmental support. He also discusses the funding of the Survey. Archaeology has always played a major role in the formation of Indian national identity.

The author says that it is not easy to define the relationship between archaeology and nationalism in India. He says the nationalist image of the 'glories of ancient India' derived some support from the excavations of ancient sites. The relationship between archaeology and nationalism in post - independence India is still an open question.

The fourth chapter 'Religious Fundamentalism, Archaeology and the problem of the preservation of Archaeological Heritage in Modern India' briefly points out three specific situations, which may be linked prima facie to religious fundamentalism of one kind or other. This has posed serious challenges to the efficacy of archaeological heritage preservation in south Asia. Fundamentalism is not an exclusive feature of any particular religious group. He found that it was impossible to believe that the preservation of archaeological monuments remained completely immune to such a cataclysmic event as the Partition. The case of the Bamiyan Buddha in Afghanistan at the junction of West, Central, and south Asia and the demolition of a mosque built in the sixteenth century at Ayodhya in north India in December 1992 are major examples of religious fundamentalism affecting archaeological heritage in South Asia. He gives some important features about the Bamiyan site located in the Bamiyan valley of the Hindukush at an elevation of about 2600 m.

India is identified as the Aryan homeland. Chakrabarti says that the historical controversy, which is being waged at present in India between the 'progressives' and the 'reactionaries', has shifted from Ayodhya to the Aryans. He also discusses the development of archaeological conservation in India. The Government of India had a conservation policy in place in the early twentieth century. John Marshall the Director General of the Archaeological Survey of India says that the deserted monuments or 'dead' monuments were taken over directly by the government and 'protected'.

In the last chapter of this book 'the Common Denominators of Third World Archaeology' the author explains the term, 'Third World'. In this chapter the author says that the archaeological literature has focused on diverse ramifications of the socio-politics of the past but there is no specific theoretical concern with archaeological research in the Third World. So, he points out that the gap both in scale and research methods between the First and the Third World is increasing at an alarming speed.

Emphasizing the common denominators of Third World Archaeology with the help of colonial background he tells us that the Third World Archaeology in the colonial context was a small government–run affair, which hardly played any role in its educational system or in nationalist movements. He also gives a brief note on the situation after Independence. The author says that there are about eleven common denominators of the Third World Archaeology. He compares the Third World Archaeology to the First World Archaeology in the field of reconstruction of archaeological cultural history with emphasis on survey and excavation, oriented towards the establishment of stratigraphy, typology, distribution and dating.

In the end of the book the author has added a theme on the Nationalist Archaeology of India. He says that the fact that Nationalism can also act as great cultural force persuading people to undertake the study of not merely archaeology but also history has not been adequately emphasized.

The author refers to many multi-ethnic states. The Turkish situation has a similarity with the Indian case. Both are multi-ethnic states with deep roots in history, and the past acceptable to all sections of populace is important to both of them. The author recognizes that there is an increasing emphasis upon finding links between archaeology and nationalism since 1990. Chakrabarti also emphasizes that the Indian identity, built within the colonial Indological framework of race, language and culture and its Aryan-non-Aryan dichotomy, is unacceptable to modern

India and Indians. He also discusses some important concepts about the race-language-culture framework in colonial India, the acceptance of the race-language-culture framework by Indian historians and archaeologists, and the need of a different concept of the past in modern India.

Two points are carefully emphasized throughout the volume by the author. First, there is a strong thread of continuity through the period covered by him. The discoveries of one period were linked with the discoveries of the next. Secondly, such discoveries did not take place in an intellectual vacuum. The present volume is based only on the published material and aimed at dealing with the overall and evolving frame of archaeological research in post-Independence India. Finally, it is important that we realize that there is an ever-widening gulf of difference between the archaeological research in the First World and in the third World.

To sum up, Chakrabarti's book does stimulate one to think about the serious issues he has raised. He calls the book, *Archaeology in the Third World,* but mostly it is India he is talking about, so why claim the whole Third World? His book is published in 2003, but most of his references belong to the nineties. He has criticized my book *Archaeology of India,* which was published in 1982, but after 1982 he ignores the several books I and others have published on Indian archaeology. This lapse makes his book a bit out of date and superficial. The author is no doubt very prolific but publishing too much too often leads to superficiality and lack of depth, which used to be the hallmark of Chakrabarti's books. All the same, the book is a must for all those interested in the history of Indian Archaeology.

D.P. Agrawal
dp_almora@indiatimes.com

Book Review

Yoshinori Yasuda (Ed.). 2002. *The Origins of Pottery and Agriculture*. New Delhi: Roli Books Pvt. Ltd. Pp. 400. Price not given.

This book is about the origins of agriculture, animal husbandry and ceramic technology. This is in many ways a revolutionary book as it forces one to a paradigm shift regarding the origins of agriculture and pottery. To appreciate the import of the book, it may be useful to introduce some basic concepts.

Beginnings of agriculture and husbanding animals involved their domestication, which itself is a bit of a polemical issue. Some time back Lamberg-Karlovsky, the well-known Harvard archaeologist, had explained these issues. His observations are relevant even today.

"The definition of food production is in part dependent upon the ambiguous concept of domestication itself. Domestication is best seen as a continuum of relationships among human beings, plants, and animals. It is often difficult, if not impossible, to distinguish morphologically domesticated from wild plants. For some plants the essential factor in domestication is a shift in adaptation to new habitats that are modified or destroyed by people; the emphasis is on ecological rather than morphological change. Some domesticated plants like maize, dates, bananas, breadfruit are forever tied to people, having lost their independent power of seed dispersal and germination; others, even if controlled or manipulated by humans, revert to the original wild state if not constantly tended... If it is difficult to determine the extent of domestication in past cultural systems on morphological or ecological bases, it follows that the agricultural status of a community is often ambiguous. There are degrees of food production, and the assignment must be an arbitrary one. Anthropologists and archaeologists can, however, agree on a working definition of domestication that posits, at a minimum, (1) a reasonably efficient level of food production entailing situations in which food acquired through direct production amounts to over half of the community's dietary needs for part of the year; and (2) both plant and animal domesticates are no longer bound to their natural habitat" (Lamberg-Karlovsky 1979: 85-89).

The advent of agriculture was no ordinary event in human evolution. Agriculture allowed us to sustain very large populations. About 100 kyr ago the population was only about 10,000 and now very soon we will be crossing the 10 billion mark — a million-fold increase in just a few millennia! Though we generally regard hunting-gathering as a primitive stage and attribute civilisation to agricultural surplus, agriculture brought several problems with it. The easily digestible food of *Homo sapiens* gradually led to shrinking of the jaw. Our jaw now can accommodate only 28 teeth. The wisdom teeth create a variety of problems when they erupt. About 15% Europeans and 30% East Asians do not grow more than 30 teeth. During the last 10 kyr *H. sapiens* is shrinking. From Cro-Magnon man's 6' height, it has come down to 5'8" today. Even our brains are shrinking. Molleson (1994), who studied skeletons from Abu Hureyra (Syria) dating back to 11.5–7.5 kyr, found that daily grinding of grain for several hours resulted in damaged discs and crushed vertebrae. Maize cultivation, which started 8000 years back by the American Indians, resulted in a severalfold increase in tooth cavities, anaemia, tuberculosis, yaws, arthritis and syphilis. Almost 1/5th of the population died in infancy. Dense populations led to a variety of epidemics. Agriculture and ceramic technology had a dramatic effect as porridge could now substitute the breast milk. Regular breast-feeding suppresses ovulation and weaning of infants from breast milk led to more frequent pregnancies and an increase in population.

One has then to ask: If agriculture brought such disasters then why did humans opt for it? The answer is simple. Farming allowed a larger number of people to sustain themselves over a piece of land than would hunting-gathering. However, hunting-gathering life-style had its own advantages. The physical exertion of hunting kept us in good health (Stringer and McKie 1996). Possehl has made some interesting remarks in praise of hunting gathering life-style: The intensified "foraging " strategies of antiquity may have provided a very good, balanced, reliable food supply with relatively low labour inputs. All of which seems to suggest that the life of hunter-gatherer might have been quite good: ample leisure time, a balanced diet, and a reliable food supply.

With this backdrop, we will now discuss in some detail the formidable multidisciplinary evidence that the book marshals.

A few words about the editor. Yoshinori Yasuda, is a Professor at the International Research Centre for Japanese Studies (IRCJS/(Nichbunken) in Kyoto since 1994. In 1980 Yasuda established the first unit of environmental archaeology in Japan and has been a pioneer in this field and has worked In West Asia, Mongolia, Rajasthan (India), China and of course at several sites in Japan. He thus is perhaps the best-suited scholar to undertake this global survey. The articles present an integrated picture of palaeoclimatic changes, technology, agriculture, animal husbandry, and of course the human society.

The book gives due importance to high-resolution paleoenvironmental evidence. "The studies of the high-resolution palaeoclimatic reconstruction were carried out on the glacial annual varves and lacustrine annual varves. Especially in recent decades, the studies of high-resolution lake sediments have, been conducted by the European Lake Drilling Programme (ELDP) and the Asian Lake Drilling Programme (ALDP). By these studies of high-resolution analyses for the palaeoenvironment, we have been able to establish a new chronology based on calendar years and to get more detailed evidence of palaeoclimate and environment in the Glacial/Post-glacial transition. These have opened a new field to solve the origins of pottery and agriculture, which will be discussed in this book, and the ages based on conventional ^{14}C dates and calibrated calendar years distinguished. The conventional ^{14}C dates are noted as ^{14}C yrs. B.P. or yrs. B.P., calibrated calendar years as cal. yrs. B.P. or B.C. and varve chronology as varve yrs. BP in this book.

In the Introduction, Yasuda emphatically claims, "This book makes it clear that the origins of pottery and agriculture in the East precede their origins in the West. The conventional view that the East has been behind the West until now will be completely reversed in this book at least in terms of the origins of pottery and agriculture. The difference of the origins and tradition in the East and the West also brought significant influence to the development of subsequent Eastern and Western civilizations. It should lead also to rediscovery of value of Eastern civilization in the history of human civilization, which has been overlooked for a long time. Being based on a pluralistic view and carrying out comparative studies of the East and the West, this book takes to the construction of the new history of human civilization."

Agriculture is one of the most climate-sensitive economic activities of mankind. The present book discusses the origins of pottery, as well as of wheat and rice cultivation. It incorporates the results of the most recent research carried out in eastern and western worlds, in relation to the man-land relationship, and brings out the basic differences between the East and the West.

This edited volume has five different sections, which contain a total of 24 articles by well-known scholars in different fields. The first section deals with the origins of agriculture in West Asia and contains 6 chapters. Second section is "Origins of Pottery and Agriculture in East Asia" which has nine articles. Third section "Origin of Pottery and Rice Cultivation in Japan" contains six articles contributed by various authors. Fourth section has only three articles. Section five contains the conclusions drawn by Yasuda, the editor. It's a multidisciplinary book synthesizing palaeoclimatic, genetic, archaeological and archaeobotanical data. In recent years no such book has been attempted with such a holistic integration of multiple evidence covering almost the whole world, though with an emphasis on East Asia. It is richly illustrated with a large number of plots and graphs. In its get up, it looks like a coffee table book.

First Section

Yasuda contributes the first article (after the Introduction) of this book on the topic of origin of agriculture in West Asia. According to Yasuda, the people of West Asia were the pioneers who began farming wheat and initiated the Neolithic Revolution in several parts of Asia and Europe. He further emphasizes that wheat agriculture first appeared in the basins of major river valleys in the semi arid regions of the Euphrates, the Tigris, the Nile, the Indus, and subsequently spread gradually to Europe, where this crop was responsible for the development of Western civilization.

At the end of the Last-glacial period there was a characteristic cold and dry climatic phase called the 'Younger Dryas'. Ofer Bar-Yosef, the well known prehistorian specializing on West Asia, in the next article, discusses the role of the Younger Dryas in the origins of agriculture in southwestern Asia, specifically in the Levant. The role of the Younger Dryas in the origin of agriculture was first recognised by Bar-Yosef and Belfer-Cohen.

The third article of this section is "Holocene Environmental Change and the Transition to Agriculture in Southwest Asia and North-east Asia" by Fekri A. Hassan, an Egyptian archaeologist now working at Institute of Archaeology, London. In this paper, Fekri focuses light on the emergence of food production in Southwest Asia and the neighboring areas in northeast Africa. He deals here with the outlines of a model that attempts to explain the beginning of agriculture in southwest Asia and the subsequent spread of plant and animal domestication into the Nile valley. He also briefly discusses the origins of plant and animal domestication in the Nile valley, suggesting that wheat and barley were favoured at the expense of sorghum in Egypt.

Next article is "Late Glacial and Holocene Palaeoenvironmental Changes and the Origin of Agriculture in Central Europe" by Bernd Zolitschka and Jorg F.W. Negendank, who have specialized in high-resolution palaeoclimatic research.

The fifth article is "The Earliest Agriculture and Pottery in South Asia" by D.P. Agrawal. In this paper Agrawal presents a review of the urbanization processes in the light of palaeoclimatic data in the Indian subcontinent. According to the writer the Indian subcontinent has all the ingredients that go into the making of a civilization in terms of the early Holocene occurrences of domesticated plants and animals, as also early ceramic technology. According to him, early agriculture in the Ganga valley goes back to 7000-8000 years B.P. He describes here the multiple data related to early agricultural processes.

Vasant Shinde, an archaeologist from Pune (India), contributes the last article of this section. He deals with the development and spread of agricultural communities in South Asia. He tries to establish the chronology of development of the early agricultural communities in South Asia between 9000-3000 years B.P. and delineates how the fertile regions of the Indus and Saraswati basins gave birth to the first farming communities of India. Shinde illustrates his essay with relevant archaeological photographs.

Second Section

Second section of this book is devoted to the origins of pottery and agriculture in East Asia. This is the most important part of the book as it presents for the first time an integrated review of the origins of pottery making and rice cultivation in East Asian regions. In his article Yasuda presents radiocarbon dates on the early pottery and rice farming sites of East Asia, like the Chinese sites of Liuzhou Dalongtan Liyuzusi, Miyaoyan, Yuchanyan , Bashidang, Pentoushan; Russian sites of Khummi, Gasya; and the Japanese sites of Fukuidokutsu, Kamikuroiwa Iwakage, etc.

There are many controversies with regard to the origin of Asian cultivated rice in terms of its ancestors and phylogenetic relationship. Molecular genetic analysis suggests multiple parentages of the two major varietal groups of cultivars, *indica* and *japonica*. And a recent archaeological study in China suggested that incipient *japonica* cultivation was initiated in the middle and lower basins of the Yangtze River.

In the next article of this section, Yo-Ichiro Sato emphasizes the new hypothesis on the geographic origin and phylogeny of cultivated rice. And he concludes that the *japonica* variety, a type of *rufipogon*, was probably born in the middle and lower basin of the Yangtze River about 10,000 years ago.

The next article is "The Origin of Rice Agriculture, Pottery and Cities" by Yan Wenming. Wenming has three main headings and each of the heading covers a separate topic.

Yuchanyan, popularly known as the frog cave in Chinese, is located in Shouyan town, Dao Country, Hunan Province. Dao Country sits in a basin surrounded by high mountains like Nanliang, with limestone hills nearby. Yuan Jiarong describes the origin of rice and pottery in Yuchanyan, Dao Country, Hunan Province in his article. He concludes that the cultural deposits found in the Yuchanyan cave are typical for south China during the early Holocene and characteristic of the transition period from the Upper Palaeolithic to the early Neolithic. The AMS and conventional radiocarbon analysis of three different materials at Yuchanyan cave shows that pottery production began in the Upper Palaeolithic in China.

The next two articles of this book are "Rice Paddy Agriculture and Pottery from the Middle reaches of the Yangtze River" and "Early Pottery and Rice Phytolith Remains from Xianrendong and Diaotonghuan Sits, Wannian, Jiangxi Province" by Pei Anpind and Zhang Chi, respectively. These two articles are very detailed and very informative.

Guo Ruihai and Li Jun present the next paper describing the beginnings of agriculture and pottery in North China with special reference to the Nanzhuangtou and Hutouliang sites. The Nanzhuangtou site is located at the western edge of the North China plain, 15 km east of the Taihang Mountains and 35 km west of lake Baiyangdian. And the Hutouliang sites are located in the Nihewan basin of northwestern Hebei Province. These two archaeological sites are the most important sites of China. Authors try to find out the origin of the agriculture and pottery making in North China with the help of these two sites.

The next two articles are "The Bi-Peak-Tubercle of Rice, the Character of Ancient Rice and the Origin of Cultivated Rice" by Zang Wenxu and "New Perspectives on the Transition to Agriculture in China" by David Joel Cohen.

Third Section

It contains articles by well-known writers and is devoted to the origin of pottery and rice cultivation in Japan. First article of this section is "The Meaning of agriculture for Humans" by Masaki Nishida. This is a very interesting paper. The author puts up a few issues in his article:

(1) Why were starchy seeds, the most common and important food for humans today, not efficiently utilized as a food resource until around ten thousand years ago?

(2) What is the causal relationship between the beginning of the use of starchy seeds and the emergence of sedentary communities?

(3) What is the relationship between the sedentary way of life and the domestication of plants?

(4) What is the relationship between the domestication of grass, and agriculture, and the emergence of cities and states?

The next article investigates the origins of pottery and human adaptation strategies during the termination of the last-glacial period in the Japanese archipelago by Takashi Tsutsumi. Three points are discussed in this article by the author: (1) a brief outline of environmental changes during the termination of the Last-glacial period and archaeological chronology; (2) Origin and types of pottery in each period, and respective functions; and (3) Changes in the ecosystem and subsistence strategies such as hunting, gathering and fishing, as well as changes in strategies for adaptations to cold and warm, establishment of settlements and procurement of natural resourses.

Shuichi Toyama in the next paper examines the origins and expansion of rice cultivation based on the environmental-archaeological survey throughout China and Japan, and also discusses the origins and development of the rice cultivation in Japan.

The next article is "The Origin and Development of Rice Paddy Cultivation in Japan Based on Evidence form Insect and Diatom Fossils" by Yuichi Mori. In this article, the author describes diatom and insect fossils found at several sites of historical remains, and discusses how rice paddy cultivation affected the biotic community in Japan.

The next article titled "Commentary on the Productive Capacity of Early Japanese Rice Farming" is by Kaoru Terasawa. And at the last of this section, Yoshiyuki Kuraku discusses the origin and development of rice cultivation in Japan.

Fourth Section

It is given to "Global Environmental and Food Problem in the 21st Century" and contains only three articles. First article of this section is "Global Climate Change and Food Problem" by Tsuneyuki Morita and Yuzuru Matsuoka. In this paper authors describe the Asia-Pacific Integrated Simulation Model (AIM).

Hiroshi Tsujii, in his article named "The Special Characteristics of the International Rice Market and their implications for rice Self-sufficiency Policy in the 21st Century" describe the rice policies of Asian countries and puts up the question that how can we be able to provide an abundant and sustainable supply of cereals in the 21st Century? Last article of this book is "Rice Planting and the Global Environment Crisis: The Message from Japanese Rice Planting Folk Customs" by Kanichi Nomoto.

Fifth Section

At the end of the book, Yoshinori Yasuda presents the final conclusion, entitled "Shift from Monistic to Pluralistic View of Civilization".

Thus we see that this valuable monograph presents the latest multi-disciplinary evidence from across the globe on the beginnings of ceramics and agriculture. The editor asks for a paradigm shift in our thinking regarding the origins of these technologies and marshals a formidable array of data to prove that the East (China and Japan) preceded West Asia in the origins of these technologies.

The book doesn't only deal with the bygone past. It has a relevance to the future too. Yasuda says, "After the agricultural revolution, *Homo sapiens* ruled over nature, killed other animals, destroyed the forest, polluted air and water and created a kingdom suitable only for *Homo sapiens* on the earth. His desire for endless expansion caused many environmental problems on this living earth. Today's environmental crisis on the earth, which is shaking the very foundation of life, was predicted when *Homo sapiens* succeeded in the agricultural revolution." This reminds us the famous saying of Gandhi, that the nature has enough for everybody's needs but not for their greed.

We strongly recommend the book for those interested not only in the fields of world archaeology, origins of agriculture and ceramics, but also in the future of humankind.

References

Lamberg-Karlovsky, C.C. 1979. Hunters, Farmers and Civilizations: Old World Archaeology; Neolithic villagers and Farmers, *Scientific American*. 7 June 2003: 85-89.

Molleson, T.1994. The Eloquent Bones of Abu Hureyra, *Scientific American* August: 60-65.

Stringer, Chris and Robin McKie 1996. *African Exodus*. London: Jonathan Cape.

D.P. Agrawal and **Lalit Tiwari**
dp_almora@indiatimes.com

Book Review

Pande, Girija and Jan af Gejierstam (Ed.) 2002.
Tradition and Innovation in the History of Iron Making.
Nainital: PAHAR. Pp. 443. Price Rs. 1000/- (US $ 60)

The history of iron stretches back a few millennia and its use has greatly influenced the course of human civilization. Iron has several intrinsic merits over copper, hence it eventually replaced bronze, but not because it was any harder than the latter. The first quality of iron is its sheer abundance. By an 'iron catastrophe' it probably melted and sank to the core of the Earth early in the history of this planet, becoming the planet's dominant element. On heating iron has the capacity to change crystalline form (from a body-centred cubic to a face-centred cubic lattice), which allows it to be quenched into hard steel, endowing it with special structural and aesthetic qualities. The last important quality of iron is that it accepts carbon and other materials into an interstitial solution.

In this volume the issues related to the dynamic interrelationship between man and nature, technology and culture, iron and society are addressed at length by a multi-disciplinary group of archaeologists, metallurgists, anthropologists, geologists and economic-historians from India, Sweden, Wales, Bhutan and the United States. The main value of the book lies in covering the whole gamut of iron technology from the close of the Second millennium B.C. to recent times. Its value perhaps lies more in the late historical accounts of iron technology. Thus it's a harmonious blend of prehistory, ethnography and history of iron technology in Indian and Europe. The book also focuses on the dichotomy of the traditional eco-friendly technologies and modern industrialization.

The cream of the book is the Foreword by S. Bhattacharya. He provides an intellectual perspective to the issues addressed in the book. He very aptly describes the conference as "an unusual interdisciplinary exercise where scholars of different backgrounds and nationality get together to present their ideas on a research area... This book is a rare example of inter-disciplinary scholarly enterprise." In fact, the title of the book *Tradition and Innovation in the History of Iron-making: An Indo-European Perspective* itself was suggested by Bhattacharya.

Bhattacharya defines the core issues as follows:

- What makes such a transition from traditional techniques to modern technology difficult in some societies and easier in other ones?
- What accounts for the success of innovations in Western Europe, chiefly Sweden in this book, while in another society, such as India, innovations of analogous kind were not generated internally or rapidly internalised from outside?
- Whereas we find a fairly high level of technique of iron production in India from ancient times, what caused iron production to stagnate and how to account for the growing technological distance between Sweden and India from the early modern period often called the "proto-industrial" phase in Europe?

Bhattacharya asks why do technical innovations which are rational face resistance from the traditional artisan or worker? An old village *Lohar* (blacksmith) of tribal origin gave this answer: When asked why he preferred the traditional leather bellows to the modern blower machine he said, "This new machine will win in the end, but it will blow my family away." What he meant was that while he worked on the anvil, his wife and children used to work on the bellows (simply by stepping on and off a lever to deflate and inflate the bellows); this collective labour keeping the family together would become redundant if the mechanical blower was used instead.

Bhattacharya wonders, did this village *Lohar* reveal values and attitudes typical of a "culture of backwardness" and an irrational response to a more efficient technique? Is there just one economic rationality based on input-output accounting or are there different orders of rationality? If economic accounting of costs and output bypasses the totality of the human situation, is it an adequate measuring rod? Such questions are implicitly raised in many of the papers in this book addressing the issue of failure of technological developments in India.

Bhattacharya reports that engineers and geologists reported how their effort to introduce the mechanical fan in place of the traditional bellows and steam-powered automatic hammer failed because of the native artisans' rejection of these improved machines. The reasons for that rejection were not attitudinal or 'cultural'. The real reasons were: (a) the disruption of the family unit as a result of the innovations, (b) the disruption of the link of inter-dependence between two social groups, the *Agarias* (smelters who made the iron blooms) and the *Lohars*; (c) the problems caused by the concentration of many production units in one place to make the use of the mechanical blower cost effective; (d) finally, the new machines were expensive imported ones beyond the reach of the limited resources of the artisans and therefore made the entry of a machine owner inevitable. Bhattacharya suggested that the consequent separation of the iron workers from the ownership and control of the means of production was possibly a reason for their resistance to the innovation.

Jan af Geijerstam and Girija Pande's papers on Kumaun iron works in this book provide excellent examples of institutional innovation, by way of reorganising production and consequently relationships between workers, managers, experts, owners, etc.

Now, how to account for it? One sort of answer to the question would be that there was a disjuncture in cultural continuity due to foreign invasions and alien rule unsympathetic to Hindu arts and science, etc. But this kind of explanation, popular with those who are content to extol the great past, does not suffice: why was this alleged amnesia massively evident in branches of science other than medicine, astronomy and mathematics, and why did it not delete from memory the *Dharmasastras* and the ritual prescriptions and proscriptions which sat heavily on the Hindu mind?

D.D. Kosambi thought that the technological stagnation (which arguably is a consequence of de-linking of technology of craft operations from scientific knowledge of their rationale) was to be attributed to the caste system: "the low caste status of the (artisan) practitioners and the contempt for science on the part of their betters, prevented full development as in the West." It is for experts in ancient India to tell us how well-founded this explanation is, but *prima facie* Bhattacharya thinks that it is a reasonable explanation.

Let us now turn to the detailed contents of the book.

The volume opens with two specially written notes, the foreword by Prof. Savyasachi Bhattacharya and Introduction by Prof. Deepak Kumar and Mritunjay Kumar. This edited book has five different sections, which contains 25 articles by well-known scholars.

The first section, *"Ancient Iron and Steel and the Inception of New Technologies"* discusses the inception of iron making both in India and Sweden in 5 articles. The second section, *"Interdependence and Change on the Verge of Industrialism"* includes 6 articles, discussing the late pre-industrial and the early industrial period. The third section, *"Traditional Iron Making; Transition and Survival"* contains 5 articles that deal with traditional iron making in India. Section 4, "Twentieth *Century Change and Restructuring"* is a small section comprising 4 articles and deals with twentieth century change and restructuring of the iron and steel industry. The last section of the volume, *"Sweden and Kumaun: An Introduction in Historical Context"* covers the basic theme of iron in 5 articles.

This book includes forty-four illustrations including some very rare historical pictures, maps and graphs. The book contains a number of tables showing data related to the ancient iron industry. The book is divided into five sections.

Section I

The first section looks into the development of traditional methods of iron making in India and Sweden and also the various theories associated with this stage. In the first article D.P. Agrawal and J.S. Kharakwal have discussed the different stages of technological development of iron technology. It is an endeavour to understand the issues relating to the commencement, development and dissemination of iron technology. The essay formulates the main outstanding issues of iron technology in India:

- If iron technology is indigenous to India what and where are the technological stages?
- Where are the early examples of the production of the accidental iron during copper smelting?
- Did we use meteoritic iron in India?
- Why was cast iron making was so late in India. What are the stages of steel making? Was there an ornamental stage of iron use in India too when it was valued as a precious metal.
- What are the developmental stages of making Wootz iron and how extensive was its use?
- In what way did iron contributed to the socio-economic processes associated with the second urbanisation?
- When does iron effectively replace bronze and stone?
- What role does the Central Himalayas played in providing iron and its technology to the Ganga Valley?
- Did early iron technology come with some Indo-Aryan groups?
- How are the multiple foci of early Iron technology related to each other, if at all?

- What is the absolute chronological framework of early Iron Age based on calibrated radiocarbon and TL dates? Now that AMS dating is going to be available at the Institute of Physics at Bhuvaneshwar, we should be able to date the actual iron artefacts and slag so that there is no ambiguity about relating the age of an iron artefact and the date based on charcoal.

The second article, "*The Inception of Iron and Steel Making in India*" by Bhanu Prakash refutes the stand taken by scholars like Lahiri and Chakrabarti who talk about the use of iron even during the early Bronze Age but fail to prove the same. Prakash refers to the use of *Ayas, Hiranya* in *Rigveda* and *Lohavid* and *Dhatuvid* in later literature and also mentions *Agni* and *Havankunda,* which were used in processing of iron. According to him the process of steel making, its forging technology and heat treatment were definitely developed in India while other countries were producing only copper and bronze weapons or weapons made of wrought iron.

The third brief article, "*Iron and Steel in Ancient India*" by Friedrich Toussaint tries to look into the early iron making in India.

In the next article, "*Some Aspects of Iron Working in Antiquity vis-à-vis Central Himalayas*" M.P. Joshi portrays the traditional iron working practices in the Central Himalayas. His own perception is that "although central Himalayas had great potential, iron working could not have gained momentum here until seventh century AD. This was until the time when iron was used on a large scale in the making of non-utilitarian items like small and colossal votive tridents, clamps for bending stone slabs in the construction of temples and forts, etc." The last article of the first section discusses the various techniques and processes in Sweden as they evolved during the first two millennia.

Section II

In the first article of this section the authors have compared the organizational structures of the iron industries of Sweden and Britain, both of which employed different strategies for the production of iron. The authors also suggest that the differences between the two countries were responsible for the different modes of acquisition and dissemination of the technological information.

In the next article, Thelma Lowe argues at length the role of VOC (*Veerenidge Oost-Indische Compagine*) in maintaining a standard of intra and inter-Asian trade, especially in the case of India and Sweden. According to Lowe both Indians and Swedes benefited from the VOC's global trade and generated wealth all along the network of transactions.

The article by Ishrat Alam is a study of iron manufacturing in Golconda in India under the direction of Dutch East India Company. Ishrat Alam describes the role of this Company in various aspects of iron, steel, nail and cannon ball manufacturing and in their export to South- East Asia and Persia during the seventeenth century. The Dutch East India Company had established nail-making centres at Ponnepilly, Nagaluancha, Rammellepatnam, Narsapore and Palicot. However, iron manufacturing in Golconda relied mostly on craftsmanship and had little to do with the technological innovations.

Maria Nissar in her article gives a brief description of the Swedish iron and steel industry and also describes its development through the ages. According to her this development can be divided into six different phases. Each phase was known for some special features, but together these phases provide a chronological development of the Swedish industry. The developments of new technology like blast furnace, German technical influences, immigration, and foreign capital were some of the important features that helped tremendously in its growth and prosperity.

The article, "*Iron Making in Kumaun: a Study of Kumaun Iron Works*", written by Girija Pande is a study of the iron making practices in Kumaun and how the pre-colonial and colonial structures influenced their needs and practices. Pande quotes Hearsay:

> "The Gorkhas are not aware of the resources of the country, they now hold in Garhwal. There are rich copper mines, iron in great abundance. Tari, hemp and marts and yards of fir innumerable, sufficient to supply all the navy of England... If the country was given back to the former rajah a great flow of commerce would take place, highly beneficial to the Great Britain and British commodities would, by the Rootwal, passes of Neetee, Mana, Juari and Tucklakote find their way into Tartary and even in China."

Uttarakhand has an old tradition in iron metallurgy. The rich natural resources of Kumaun were at the top of the British agenda. Therefore after an elaborate survey, they started the iron works, but due to fuel crisis, mismanagement and the initial setback of market for the finished product, the government ordered it closed. In the process they also destroyed the social fabric of the Himalayas. This in turn resulted in the collapse of the highly developed traditional iron technology and the rural economy of the land.

The last article of the second section raises crucial questions about technology transfer, the interdependence between technological changes and cultural/social conditions and the issue of power and subordination. This article by Geijerstam also gives the chronology of iron making in Kumaun in 5 phases. Precisely because of its lack of success, this story of the Kumaun Iron Works is important. The inability to achieve full scale and steady production pinpoints obstacles to development and highlights conflicts. It helps us paint part of the picture forming the background of today's world. Geijerstam presents a true picture of the colonial mindset, which failed to match with the true sprit of the technology transfer in the real sense.

Section III

The third section begins with the article "*Studying India's Indigenous Iron Industry: Looking for an Alternative Approach*" by Smriti Kumar. It is an analytical study. Kumar believes that research in this field is more Eurocentric. He divides the existing literature on the indigenous iron and steel industry of India into four categories; (1) Archaeological studies based on evidence of the early use of iron and iron making in India; (2) Historical studies based on eighteenth and early nineteenth century; (3) Metallurgical and theoretical studies based on historical evidence and on the specimens of early Indian iron and steel; (4) Some experiments aimed at rejuvenating and re-correcting the earliest system of knowledge. Kumar also talks about the vertical and horizontal expansion of the craft technique. It's a very perceptive and thought provoking essay emphasizing the significance of the transition of the tribal Jharkhand craft of the nomadic Asur iron smelters to Koth-Saal workshop. Thus this paper is really an effort to draw attention of scholars to an important area of research in India, which has been only inadequately studied so far.

The article by Vibha Tripathi is very critical of the modern means of producing iron and steel, which are expensive, less eco-friendly and rendering people unemployed. Tripathi looks into the iron and steel making practices of ancient India and also attempts to identify methods and mechanisms to make them economically viable in the modern age. The author believes that the old ways of iron and steel production technique could be modified by a slight alteration. Similarly a group of scientists from National Metallurgical Laboratory, Jamshedpur, tries to show how the ancient methods could be made viable in present scenario. According to Vibha Tripathi, it is never too late to rethink and review our policies for social, cultural and ecological well being of all. It would not only benefit the cultural and physical ecology, but also reinvent our cultural heritage with a glorious past.

The next essay is an attempt to represent the critical analysis of the performance of ancient iron making process. The successful operation of the primitive iron-making furnace is directly related to CO/CO_2 ratio in the reduction zone and the size and porosity of iron ore lumps.

R.M. Nayal and Nilanjan have tried to study the tribal population engaged in iron manufacturing so that possible methods could be devised to rehabilitate and re-employ the tribal people. This will save the traditional iron smelters from becoming jobless, or from being diverted to seasonal employmen.

In the last article of this section, Raghubir Chand describes the diffusion of Indian iron making practices to Bhutan. It may safely be assumed that the pre-industrial smelters of Assam might have supplied iron to build the castle in Bhutan. Barshongpas — the inhabitants of village Bershog in Khaling gewoj of Trashigang Dzonkhag of eastern Bhutan are even today involved in the iron ore extraction and smelting in Bhutan.

Section IV

The first article of the fourth section is "*The Recent Restructuring of the Swedish Steel Industry*" by Orvar Nyquist. The article is about the Swedish iron and steel industry and the changes it witnessed in post Second World War scenario. Orvar Nyquist writes that these changes in 50 years or so almost re-structured the iron making process in Sweden. The iron and steel industry of Sweden underwent two restructurings: (1) 1978-1982 and (2) 1986-1991. This involved the transfer of state ownership to private as well as the formation of Joint Stock Company. The author also writes about the negative influence of politics and unions on these industries.

A.K. Lahiri in his article traces the historical developments in iron and steel industry in India with a view to find out the factors that resulted in its stunted growth. The iron and steel technology followed the world trend but the growth rate of capacity and production all along had been low. The author says that scarce capital and non-availability of foreign exchange were partly responsible for it. The other important factors were (1) time and cost overrun, (2) low growth of steel consuming industries, and (3) non-availability of indigenous technology.

In the last article of the fourth section Edstrom and Seetharaman provide a review of the Swedish methods evolved during the 70's for the production of hot metal using ore concentrates and cheap coal. The new technologies developed during this period were furnace in ELRED, flash smelting in INRED and plasma technology in PLASMASMELT. Of these processes, the PLASMASMELT method was expected to have the lowest capital investment and to allow optimal use of energy. ELRED was expected to be adaptable in countries with cheap fossil fuels and high electricity prices. This paper gives a hint of what may come in future.

Section V

The first article in the last section attempts to introduce Sweden and its rich flora and fauna. In this article Jan af Geijerstam argues that the easy availability of iron ore, favourable climatic conditions, good labour-capital relationship and good education of the Swedish people helped in making industrial life a success. The second article in this section by Shekhar Pathak, tries to introduce the geography and history of Uttaranchal region in some detail. Ajay Rawat in the article *"Managing Forests in Kumaun Himalaya"* describes the colonial forest policy and people's protest against it.

Gabriel Bladh gives an interesting account of the role of forests in iron making in Sweden in his article "*Wood Fuel for the Mines and for Charcoal: The Exploitation of the Bergslange Area during the Period 1500-1900*". According to the author access to forest for wood fuel for the mines and charcoal became a necessary requirement for the mining industry in the central mining and ironworks area of mid-Sweden, i.e. the Bergslagen region. In the last article of the volume, Per Hilding describes the constraints and business linkage between India and Sweden. The author also illustrates the dynamics of business relations by taking the case of Sivakasi match factory.

To sum up, in this book the authors have tried to highlight some of the issues in the history of iron making which appear to be significant in the context of economic development/regression. The book is very ambitious in trying to cover multiple facets of iron industry, the Indian tribal tradition, the traditional iron technology of Uttaranchal, the growth of iron technology in Sweden, early history of the British attempts to start iron works in Kumaun. The value of the book lies in covering the whole spectrum of issues related to the history of iron technology, its relevance today, the conflict between modernization and traditional technologies etc. At times the essays give an impression of being an odd eclectic assortment of writings that don't seem to gel together. The editors could perhaps work a bit harder to produce a more integrated version by weaving them into a cohesive narrative.

All told, this is a valuable book on various aspects of iron technology and a must for all those interested in History of Science & Technology, as also in the issues of eco-friendly development in the Third World. The organizers of the symposium owe our gratitude for bringing out such a valuable compendium on the history of iron technology.

D.P. Agrawal and **Pankaj Goyal**
dp_almora@indiatimes.com

Book Review

***Saraswati. The River that Disappeared.* 2002. K.S. Valdiya. Hyderabad: Universities Press. Pages 116. Price Rs. 175/-**

The 'Saraswati' river forms the core of perhaps the most debated issue of the appearance of the 'Aryans' in the Indian Subcontinent, in Indian archaeology and ancient history today. The problem of the 'Aryans' remains unsettled in spite of two centuries of investigations from archaeological, linguistic, palaeoanthroplogical and literary angles. The question of identifying the river 'Saraswati' that has vanished in the past, is an integral part of this issue. Several scholars (e.g. Misra 1984, 1994; Lal 2002) have discussed the idea of connecting the lost river Saraswati and the Harappan sites found in northwest India and Pakistan. The whole issue of recognizing the settlements of the Vedic people/ Aryans is extremely complex since neither the chronology nor the cultural-geographical identities of all the people/tribal communities known to us from ancient Indian literary works are universally accepted (Thapar 2000). Further, physical identification of the lost river named Saraswati, and the presence of Late Harappan/ post-Harappan Chalcolithic sites in North India is eventually tied-up with renaming of the Harappan civilization as 'Indus-Saraswati' civilization (Gupta 1996). Against this background we should look at how this book can add to our understanding of the ancient geography of North India and to what extent does it connect the lost river to the most chased-after people in Indian history — the Rigvedic Aryans. The author himself had started the research on the lost river a couple of decades ago; therefore, this book is an outcome of sustained research spread over a long time.

This book is based on rock-solid geomorphological and geohydrological data. The author has divided the book in several chapters, of which the first five introduce us to the physiographic and geological setting of North India, particularly the vast flat land between the Himalayas on the north, Aravalis in the east and river Indus (Sindhu) on the west. The author's work is mainly based on tectonic movements and the changes that have occurred in the Indian landmass in last 10,000 years. Based on pollen profiles several scientists have traced the climatic changes in the Holocene epoch. These data show that the climate in Rajasthan was wet between 8500 and 4000 years B.P. and that major rivers like the Indus provided plentiful water between 10,000 and 3000 years B.P.

The information about past climates and water availability in northwestern India is interesting not only to academics but also to common people. Particularly, the part of book dealing with 'fossil waters' found in today's dry and hot desert of Thar both in Rajasthan and Cholistan (Pakistan) is fascinating. For instance, electrical conductivity-based survey has revealed presence of freshwater at depths of 30-50 m in Jaisalmer area. Further, a comparative study of this water and that of the floodplain of the Hakra River between Fort Abbas and Fort Mojgarh revealed their similarity. While discussing the disappearance of the river and its impacts on Indian landmass, the author provides excellent visuals of past upheavals due to tectonics.

What might appeal more to common readers is the clear demonstration that rivers change their courses and the Indian landmass is slowly moving northwards towards the Himalayas. To a layperson a river seems to be a stable landscape feature and the idea that a river can shift sideways by a few kilometres is surprising. It is obvious since changes such as river diversion and movement of the landmass are beyond the lifespan of individuals or even several generations.

The glossary at the end of the book is well-designed and the book has line drawings. It, therefore, forms a good starting point for those who are new to the fields of geomorphology and geosciences. Also, colour photographs and satellite images are extremely useful to convey to laypersons the methods used in such kind of research.

In this book the author has presented the data on earthquakes in the past' and the impact such events could have had on the drainage system of North India is still at the level of an hypothesis. A satellite imagery would only locate an ancient channel of a river or stream, but will not be able to tell us how ancient is that ancient channel. A layperson is likely to catch only the words such as 'lost' and 'found' without knowing that simple enumerative inductive reasoning is used here. Therefore, it is necessary to clearly mention the methodological constraints as well as the probabilistic mode of inferences drawn while relating the geological information to that obtained from textual sources, particularly in the books meant for popular consumption. These lacunae however, do not reduce the value of the book. The author himself has clearly mentioned that he is presenting the picture of the lost river as a geoscientist and offering an analysis of geological evidence. In this regard, the author has been successful in creating a comprehensive picture of the lost Sarasvati problem and generating curiosity in the minds of laypersons.

References

Gupta, S.P. 1996. *The Indus-Saraswati Civilization. Origins, Problems and Issues.* Delhi: Pratibha Prakashan.

Lal, B.B. 2002. *The Sarasvati Flows On.* New Delhi: Aryan Book International.

Misra, V.N. 1984. Climate, a Factor in the Rise and Fall of the Indus Civilization, in *Frontiers of the Indus Civilization*, pp. 461-489. New Delhi: Books and Books.

Misra, V.N. 1994. Indus Civilization and the Rigvedic Saraswati, in *South Asian Archaeology 1993* (Asko Parpola and Peter Koskikollio Eds.), pp. 511-525. Helsinki: Suomalainen Tiedeakatemia

Thapar, R. 2000. The Rigveda Encapsulating Social Changes, in *The Making of History* (K.N. Panikkar, T.J. Byres and U. Patnaik Eds.), pp. 11-40. New Delhi: Tulika Publication.

P.P. Joglekar
Deccan College
Pune 411 006
pramjog@yahoo.co.in

Book Review

***Archaeology. Principles and Methods*. K. Rajan. 2002. Thanjavur: Manoo Pathippakam. Pages 279. Price Rs. 200/- (Paperback).**

Archaeological research today is more than a mere documentation of the artefacts and their association with culture of the past. A student of modern archaeology and history requires an understanding of both theoretical and practical issues involved in examining the past, and how the inferences are drawn. Archaeology is constantly using changing paradigms of research.

Protocols developed in many other disciplines of physical and social sciences and such fields of knowledge that just a few years ago were considered distant and unconnected. For instance, the whole field of molecular archaeology has come up with such results that they have startled scholars in a wide-spectrum of fields such as evolutionary biology, evolutionary genetics, anthropology and archaeology. Similarly, remote sensing that is one of the spin-offs of modern space science is drastically changing the methods of survey and archaeological site management. Although still a lot of knowledge of archaeological work is obtained by experience and interaction with senior research workers, students of modern archaeology must know the fundamentals of such newer techniques, their strengths and weaknesses as well as their compatibility with the traditional archaeological techniques. In this context, Rajan's book provides an excellent overview of traditional as well as newer methods used in archaeological research today.

A mere look at the contents of this book is adequate to know the depth at which the author has treated his subject. The book covers all aspects of archaeological practice: exploration and excavation techniques, laws of archaeological stratification, principles of recording archaeological data, techniques of data analysis, dating methods, and the need and use of conservation of the sites. The chapter on surveying and mapping techniques used in archaeological research gives excellent idea of the basic principles of cartography and utility of modern computer-based methods like Global Positioning System (GPS), satellite remote sensing and Geographic Information Systems (GIS). A professional archaeologist needs to know that archaeological research involves a team-effort. Also human relations do matter in deciding the ultimate quality of record that any exploration/excavation campaign generates. Dr. Rajan is aware of this extremely crucial dimension of field-oriented research. His chapter on 'archaeological staff' correctly identifies the problems of fieldwork management and provides an exhaustive list of necessary equipment.

We already have several excellent books that deal with basic archaeological research methods and their utility. Yet this book by Dr. Rajan is a valuable addition to these existing ones on the theory and methods in archaeology. Rajan's book has three conspicuous advantages over the others. Firstly, it gives an extensive account of basic archaeological methods, general goals of archaeological research and the history of archaeological enquiry in India. Therefore, a new student of archaeology comes to know from where and how the archaeology of the twentieth century has obtained its methods and modes of inference. Secondly, over last few decades several changes have occurred in archaeological theories and the way these are applied to interpret archaeological field data. For example one needs to know about the concept of culture, the New Archaeology as a school of thought, processualism and a range of post-processual approaches that have emerged in the last few years. Rajan's book covers these in a clear manner. Perhaps this is the most significant part of this book because otherwise the 'theory' part is not easily comprehensible to a common student. Thirdly, this book provides a well-compiled glossary that enables the reader to clearly comprehend the technical terms and their exact meanings.

P.P. Joglekar
Deccan College
Pune 411 006
pramjog@yahoo.co.in

Book Review

***A Re-examination of the Palaeolithic Archaeological Record of Northern Tamil Nadu, South India*, Shanti Pappu. Oxford: BAR-International Series 1003, pages 246, figures 18, tables 9, photographs 24**

The Kortallayar river basin, South India, occupies a unique position in the history of Indian archaeology. The discovery of the first Palaeolithic stone tool in the Subcontinent was made in this region in 1863 by Robert Bruce Foote. Subsequently, the region witnessed more than a century of sporadic research, which however resulted in few publications. Despite the paucity of information, concepts developed here, in particular those related to the 'Madras Handaxe tradition' of the Acheulian, and that of the relationship between culture sequences, river terraces and Pleistocene environments, determined the future course of Indian prehistoric archaeology. The paucity of published literature, the sporadic nature of research, along with conflicting observations of previous scholars called for a re-investigation of the prehistory of this region, in the light of recent theoretical and methodological advances in archaeology.

Dr. Pappu took up this challenge of re-examining this classic area in Indian archaeology. The basis of this book lies in research conducted as part of her doctoral dissertation at the Deccan College, Pune, under the guidance of Professor K. Paddayya. Five years of field investigations (1991-1995) were conducted by the author; utilizing a regional approach with a multistage survey and sampling methodology, whereby an area of 200 sq. km was surveyed. A total of 22 sites with a sample of 2012 stone tools, belonging to the Lower and Middle Palaeolithic and the Mesolithic were studied. Across the sampled areas, both 'sites' as well as 'off-sites' were plotted. Distribution maps of sites (at a regional level) and of artefacts (at the level of the site) were prepared. Studies included a consideration of Pleistocene geomorphology, site-taphonomy and lithic technology. The research forms a part of the broader objective of understanding the variability seen in the Palaeolithic record and of exploring alternate models of hominid behavioural strategies during the Middle to Late Pleistocene. Subsequently, the site of Attirampakkam was chosen for excavation; being the first in a series of excavations planned at Palaeolithic sites in this region. The book is considerably updated and also contains a brief note on her ongoing excavations at the site of Attirampakkam (1999-2003).

The book contributes in several ways, the most important being the re-examination of a region in Indian archaeology, which was more spoken of than understood. Tracing the history of archaeological research in this region, parallels the development of prehistoric research in India; reflecting both trends influenced by the West and indigenous developments. This study also follows recent trends in South Asian archaeology, which aim at re-assessing the archaeology of regions, which have witnessed a long history of research.

In his preface, the renowned prehistorian, Professor Derek Roe, states that, 'It is a pleasure to introduce this contribution by Dr. Shanti Pappu, to the Palaeolithic archaeology of an area of great importance, the Indian Sub-Continent', which has surely not yet achieved the prominence it deserves'. He proceeds to state that, 'As regards the Lower Palaeolithic section of her study, it is very pleasing to note that, in work done since her doctoral research and briefly described in this book, she has reaped the well deserved reward of discovering at the famous site of Attirampakkam an undisturbed Acheulian horizon in laminated clay, representing a flood-plain context, with faunal remains and animal footprints preserved, unique in India'.

The book is divided into 5 chapters, with 6 appendices, and is richly illustrated with photographs and figures of stratigraphic sections and stone tools.

Chapter 1 (Introduction). puts forward the conceptual aims and methodology adopted for the study of past hominid behaviour. It also examines the history of prehistoric archaeology in the region, beginning with the work conducted by Robert Bruce Foote in the 19th century. Dr. Pappu proceeds to discuss the work of de Terra and Paterson and V.D. Krishnaswami and examines the concept of river terraces and culture sequences built up by them. In particular, the work of these scholars is placed within the context of ongoing prehistoric archaeology in India. This chapter also discusses the current state of Indian Palaeolithic archaeology and puts forward a critique of the same.

Chapter II (The Quaternary Environment), discusses studies regarding the Quaternary Environment in the Kortallayar river basin. As a pre-requisite for examining hominid settlement or subsistence strategies, Pleistocene environmental changes required investigation. Owing to the paucity of palaeoecological data on the Pleistocene in Tamil Nadu, it was necessary to combine both field-studies of Quaternary sections with published data; and to examine geomorphic, biogenic and climatic factors which influenced the formation of archaeological sites and early hominid land-use patterns. A detailed description of each locality studied, with data on the Quaternary stratigraphic sequences, and studies of sediments and soils is put forward here. In addition to results of field studies, Dr. Pappu puts together available data on river changes in Northern Tamil Nadu, and data on sea level changes along the east coast of India. She also draws together existing information on Quaternary climatology and monsoon patterns, and on bioenvironments in Tamil Nadu. These studies indicate that the 'four-fold' terrace sequences proposed by scholars were found to be questionable. The complexity of Quaternary geomorphological processes was highlighted. Possible hypotheses of Quaternary climatic changes and associated changes in the biological environment were put forward. Archaeological data was used to assign some relative ages to the ferricretes and ferruginous gravels in the region.

Chapter III (The Archaeological Record), forms the principal component of the book and presents a detailed study of the archaeological data. It begins with a detailed discussion of the survey and sampling strategies employed, and the impact which this has on the sample studied. The chapter contains a very important section on the study of site formation processes, which is the second major contribution of this book. Such studies are a relatively recent trend in Indian archaeology and include a wide range of often conflicting approaches. In this work, the primary aim was to identify sites from which maximum behavioural information can be obtained. However, such sites, while important, are generally rare in Palaeolithic contexts and the study also attempts to examine sites with varying degrees of integrity which are thought to be of equal importance for modeling natural formation processes operating on a regional level. Sites fall into a continuum between *in situ* sites, indicating areas of hominid activity in varying degrees of integrity and 're-worked sites' where little to no information on behaviour can be obtained. This study is the first of its kind in the Indian Subcontinent as applied to Palaeolithic sites occurring in a ferricrete landscape. A survey of Lower and Middle Palaeolithic sites along the east coast of India indicates that similar artefact contexts prevail in this region as well. Thus, the methodology adopted in the Kortallayar basin would be of value for understanding sites in other areas where laterites/ferricretes predominate. Equally important is the discovery of Acheulian artefacts on and within a clay deposit at Attirampakkam, a context hitherto not noted in Peninsular India. At this site, the presence of animal footprints on the surface of this clay deposit, is further proof of the primary nature of the site and marks it as one of the most potential sites for yielding information on hominid life-ways and palaeoenvironments.

The second part of this chapter discusses the composition of assemblages at each site and draws this together to study Middle Palaeolithic technology. A wide range of reduction strategies are noted; comprising flake, prepared core, flake-blade, point, blade and biface techniques; a lack of standardization of tool forms; mild retouch; reuse of older/broken tools/cores/debitage and use of unretouched flakes, flake-blades, blades and thermal fracture flakes. Studies on variability in raw material location and types is also discusses, along with the impact this has on lithic technology and assemblage composition. Tables, charts and graphs summarize and quantify information on each stage of the reduction sequence and on variability in tool types between sites. A brief note on the presence of Acheulian and post-Middle Palaeolithic assemblages is also included. This discussion is followed up in Appendix VI, which deals with Dr. Pappu's recent excavations at the Palaeolithic site of Attirampakkam, Tiruvallur district, Tamil Nadu.

In Chapter IV (The Ethnographic record), Dr. Pappu notes that despite critiques of the use of ethnographic analogies, she made a conscious decision to incorporate general observations on South Indian and Sri Lankan hunter-gatherer settlement and subsistence strategies and their archaeological correlates. Such an approach has been used cautiously and with care taken to avoid the pitfalls of transferring models from the present to the past. She believes that in many ways, this helped in providing an experience of the hunting-gathering way of life, as practised by the Irulas inhabiting the study region.

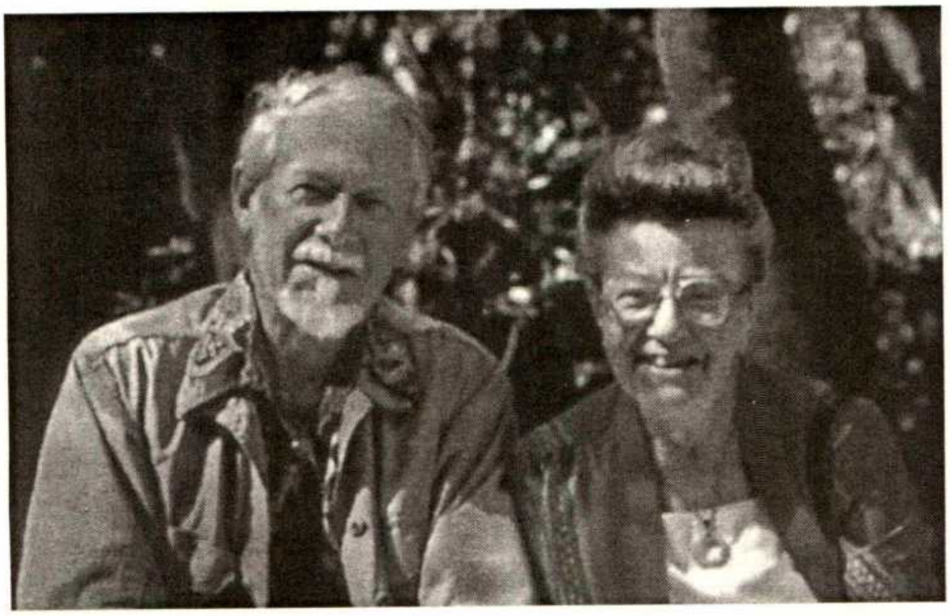
Chapter V (Hominid Adaptive Strategies), draws together all these studies in order to propose some broad based models of past land-use patterns in this region. This study highlights the necessity for the periodic revaluation of the prehistoric record of "classic" regions in Indian archaeology.

The book has several important appendices which supplement the text. The most important is the brief note on her first season of excavations at the Palaeolithic site of Attirampakkam, which in many ways updates the knowledge obtained from prior studies. These excavations which are ongoing, will yield valuable information on the South Indian Palaeolithic. This book is a major landmark in the development of methodology for Palaeolithic research, and it will be a model for future researchers to follow. The author deserves to be congratulated for her high quality research. The book is written in lucid English and is attractively produced.

This book clearly indicates that research in the Kortallayar river basin has come a long way since the first observations made by Robert Bruce Foote in 1863. It also demonstrates that even with limited resources and time, which Indian scholars suffer from, important observations on prehistoric archaeology can be made. One of the major drawbacks, which has resulted in the delay in the publication of this book review, is that the book is published by the BAR series from Oxford, which has limited circulation in India. It is hoped that Indian editions will be brought out to bring this knowledge to as wide an audience as possible.

V.N. Misra
G-2, B.Wing,Ganga Park
Mundhwa Road
Pune 411036
misravn@vsnl.net

Obituary



Professor John Desmond Clark (1916-2002) with Betty Clark (d. 2002)

John Desmond Clark, Professor Emeritus of Anthropology in the University of California at Berkeley, U.S.A., passed away on 15 February 2002 at the age of 86 years. In his death prehistory has lost a truly outstanding exponent of the 20th century, and the discipline of archaeology itself has been robbed of one of its internationally renowned spokesmen. The large circle of Desmond's friends, students and admirers spread all across the globe hardly recovered from the shock created by his death and were still exchanging reminiscences about their association with him, when the tragic news of the death of Betty Clark arrived. Betty Clark, Desmond's loving wife and life-long companion, died on 13 April in Kent, England.

Details about Clark's career and his achievements in prehistory are well documented in three long articles already available in print:

(1) Clark, J.D. 1986. Archaeological Retrospect, *Antiquity* 60: 179-188 (autobiographical account).

(2) Cooke, H.B.S., J.W.K. Harris and Karine Harris 1987. J.D. Clark: His Career and Contribution to Prehistory, *Journal of Human Evolution* 16: 549-581.

(3) Wendorf, Fred 1999 J.D. Clark, in *Encyclopaedia of Archaeology: Great Archaeologists* II (Tim Murray Ed.), pp.743-757. Santa Barbara (California): ABC-CLIO, Inc.

Based upon these writings and also deriving from our personal interaction with Desmond and Betty spread over the last quarter-century, we would like to offer a brief tribute to the memory of this couple noted both for academic excellence and for many personal qualities which endeared them to all who had come in contact with them.

Desmond Clark was born in London on 10 April 1916 in a family specialising in cosmetic business. He completed his lower school education in a boarding school at Portishead near Bristol. Already by this time he developed a taste for history and started visiting castles, Roman villas, monasteries, etc. with his father. Later on Desmond went to Monkton Combe school near Bath where, under the tutelage of two of his teachers, his interests in history and antiquarian remains were further spurred. It was therefore not surprising that he opted for history when he shifted to Christ's College in Cambridge in 1934. In 1936 he went on to enrol for the Archaeology-Anthropology Tripos which he completed with a First in 1937. Under the inspiring stewardship of Miles Burkitt and Grahame Clark, Desmond narrowed down his interests to prehistory, thereby initiating a life-long passion for the exploration of preliterate past of humanity. From Burkitt he imbibed enthusiasm for the Stone Age relics and even started visiting gravel pits and other spots in East Anglia. But it was from Grahame Clark that Desmond imbibed the need to study lithic assemblages in a systematic way and to interpret them against the environmental background. In Desmond's own words: "For me, Grahame's emphasis on palaeoecology has been all important since, without an understanding of the habitat of any prehistoric group, it is impossible to begin to understand their behaviour — why particular resources were being used, why they chose to do so in the way they did and how the changes in climate and environment brought about the particular adaptations that resulted. Grahame gave us people ..." (Clark 1986:180). Needless to emphasise, this approach has become one of the cornerstones of modern archaeology and Desmond himself put it to use assiduously in his prehistoric studies. It was also during this period that Desmond attended Sir Mortimer Wheeler's excavation at Maiden Castle and received rigorous training in field methodology including excavation.

With these qualifications in hand Desmond made some efforts to get a museum or university job in England, but without any success. However, at the end of 1937 he was offered the positions of Secretary of Rhodes-Livingstone Institute for Social Anthropology and Curator of the David Livingstone Memorial Museum in Northern Rhodesia (now Zambia). Desmond readily accepted the offer (4000 pounds per year) and reached Cape Town in January 1938 together with his fiancée Betty. Thus began Desmond's more than six-decade-long association with the Stone Age prehistory of Africa.

Betty and Desmond were soon married in Livingstone after obtaining special permission from the Governor. Desmond made many signal contributions to the study of African Stone Age, Neolithic and Iron Age cultures. Immediately after his appointment at the Livingstone Institute in 1938 he began a systematic survey of the terraces of the river Zambezi. This work enabled him to reconstruct the stratigraphical and geomorphological aspects of the terraces and also study their artifactual and faunal contents. Initially he did this work with his own money and transport but was soon given an annual grant of 15 pounds. Desmond also took up excavations at the site of Mumbwa and recognized a cultural sequence comprising the Iron Age, and Later and Middle Stone Age cultures. During this period he also began to experience the rich ethnographic record of Africa and realise its possible usefulness in archaeological reconstructions.

The outbreak of World War II put a temporary halt to Desmond's archaeological research, as he joined the Field Ambulance Corps in 1941 and also later worked in other capacities. For five years he had a chance to visit other regions of Africa such as British Somalia, Ethiopia and also Kenya where he met Louis and Mary Leakey who had already started making their well-known discoveries of fossil hominids and Early Man sites in East Africa. During less active times of this military service Desmond pursued his archaeological interests. He made a study of the Quaternary sediments of Somaliland and Ethiopia, and did two excavations - one a Later Stone Age rock shelter at Mandera and another rock shelter at Bur Eibe preserving Later and Middle Stone Age culture sequence. Desmond also made fairly large collections of stone artefacts and later used them in his Ph.D. dissertation on the Zambezi valley and prehistoric culture sequence of the Horn of Africa, submitted to Cambridge University. He fulfilled the qualification of one-year residence at Cambridge for this purpose and obtained the degree in 1951. The thesis was later published by Cambridge University Press under the title *The Prehistoric Cultures of the Horn of Africa*.

In 1951 Desmond got a new building for the Rhodes-Livingstone Museum and he was also appointed as the Secretary of National Monuments Commission for conserving and studying the historical monuments of Northern Rhodesian territory. Desmond realised the limitations of Stone Age studies (surface and secondary contexts of artefact assemblages and type-fossil approach) followed till then and was looking for a site suitable for excavation.

In 1953 he discovered the famous site of Kalambo Falls on the Zambezi plateau. Desmond's excavations here in 1953, 1959 and again in 1963 and 1964 exposed a very elaborate cultural sequence ranging from the Lower Palaeolithic to Iron Age. Desmond adopted the method of point plotting the positions of all artefacts and ecofacts exposed in the excavation. One of the special features of Kalambo Falls site concerns the recovery of various types of plant remains comprising woods, seeds, leaves and thorns. Two volumes of the results were published on this site in 1969 and 1974 respectively. The third volume, a massive one running to 700 pages and containing contributions from a dozen of his former associates including Maxine Kleindienst, Derek Roe, Nicholas Toth and Kathy Schick, appeared a few months before his death. In one of the chapters contributed to this volume, Desmond uses the evidence of modified clay lumps found in the Kalambo Falls excavation and introduces the notion of geophagy among the early hominids of East Africa. One of us (KP) had earlier mentioned that such a practice would have been widely prevalent among the Stone Age groups of India also. In fact, in many parts of rural India pregnant women belonging to the poorer sections of population still eat pellets of soft clay for replenishing mineral nutrients.

Desmond's other contributions to African prehistoric studies include archaeological surveys in central and southern Malawi, rock art of Malawi and Northern Rhodesia, recovery of a Late Stone Age sequence from Nachikufu cave containing bored stones and edge-ground axes dated to 23,000 B.P. and 10,000 B.P. respectively, and ethnographic work on the Bushmen of Zambia involving stone flaking, bone bashing and butchering practices. *The*

Prehistory of Southern Africa, published in 1959, provided a comprehensive account of all these discoveries.

Desmond's multi-sided contribution to African prehistory already earned him a name in the discipline across the world. Recognition from university circles came in the form of an offer of appointment as Professor at the University of California, Berkely. Desmond shifted to this teaching position in 1961 and remained in it for a quarter-century.

With other specialists like Sherry Washburn (non-human primate studies), Clark Howell (physical anthropology) and Elizabeth Colson (social anthropologist specialising in African peoples and cultures) already placed on its faculty, Berkeley now emerged as the strongest teaching-cum- research centre devoted to human cultural and biological evolution. Dr. Glynn Isaac from Kenya was taken on the faculty in 1966 and this gave additional strength to Early Man studies at Berkeley. Following upon his doctoral thesis on Olorgesailie, Dr. Isaac took up work on the site of Koobi Fora in Kenya. Desmond himself continued his excavations at Kalambo Falls. In Malawi he and his associates investigated the Chiwondo fossiliferous beds dated to the Early Pleistocene and also excavated the famous elephant butchery site at Mwanganda associated with small tools. In the 1970s Desmond's interests also covered the spread of the Neolithic in North Africa and he excavated the site of Shobona in the Upper Nile valley in central Sudan.

In the last decade of his service at Berkeley Desmond made another major contribution to palaeoanthropology by leading interdisciplinary teams of multinational composition to Ethiopian highlands. Noteworthy are studies on the late Pleistocene and early Holocene sites around the shores of Lake Besaka on the Ethiopian Rift and the excavation of the cave site of Pore Epic (yielding Middle Stone Age artefacts and human remains) and the rock shelter of Laga Oda (yielding Late Stone Age remains). Further, his work on the Plio-Pleistocene deposits of the headwaters of the Webe Shebele river on the Gadeb plain gave a fresh understanding of the land-use, ranging and economic activity including controlled use of fire of the Pleistocene hominids (1.5 million years). His work on the Middle Awash river deposits produced fresh and significant archaeological, palaeontological, geological and geochronological data pertaining to early hominids. His latest report on this study entitled *The Acheulean and the Plio-Pleistocene Deposits of the Middle Awash Valley, Ethiopia* (jointly edited with Jeande Heinzelin, Kathy D. Schick and W. Henry Gilbert) appeared in 2000.

A noteworthy aspect of Desmond's work in Africa is that he and Glynn not only involved Africans from several countries but trained them in both field and laboratory studies. Many of them now occupy important positions in museums, universities and government departments in Africa. The major findings of Desmond's prolonged researches into the prehistoric cultures of Africa are incorporated in his *The Prehistory of Africa* and *Atlas of African Prehistory* (correlating the distribution of ancient sites with various landscape features like soils and vegetation), which are landmark publications in prehistory and continue to inspire workers in various parts of the world.

Summing up the achievements of the team he had created at Berkeley in African prehistory, Desmond writes: "These interdisciplinary and international teams of specialists have provided knowledge of the savannah environments in which the human lineage emerged, of the favoured habitats, of dietary preferences, of the evolving biological nature of humankind as this is demonstrated by the fossil record, of the activities and patterns of behaviour that are apparent from the spatial distribution of artefacts, associated remains and features on primary context sites, and of the evolving intellectual and technical skills that resulted in the appearance of Modern Man some 40,000 years ago" (Clark 1986: 188).

Desmond's preoccupation with teaching and research in prehistory was not confined to Africa. Building upon his excellent previous contacts with prehistorians in Asia, from 1980s onwards he extended his field research into West Asian, South Asian and East Asian zones. In fact, already in 1965 he was invited by the Syrian government to excavate the open air Acheulian site of Latamne on the river Orontes; here he exposed ground plan of a shelter associated with rich and *in situ* lithic scatters. In 1982 he visited important Palaeolithic sites in Korea. In 1986 and subsequent years Desmond, together with his American colleagues like Clark Howell and Tim White, visited Palaeolithic sites in north central and southern China. In addition to visiting classic sites like Zhoukoudien, Desmond studied collections at the Institute of Vertebrate Palaeontology and Palaeoanthropology in Beijing. He promptly brought out some research papers on these visits.

Desmond's work in India deserves a special mention. With the background already provided by Professor T.D. McCown's (also from the Anthropology Department at Berkeley) joint work in the Narmada Valley with the Deccan College in early 1960s, Desmond initiated another phase of collaborative research in India. In 1978 he visited the Deccan College in Pune to take part in the International Symposium of the Indo-Pacific Prehistory Association and renewed contacts with his old friend Professor H.D. Sankalia and also formed strong links with one of us (VNM) and other prehistorians as well as doctoral students working at the Institute. During this visit Desmond also saw the ongoing excavations being carried out by VNM in the prehistoric rockshelters at Bhimbetka in Madhya Pradesh and examined the rock paintings.

Desmond and Betty returned to the Institute on several other occasions, the last one being in 1994 after attending World Archaeological Congress-3 held in New Delhi. During these visits Desmond gave lectures to the faculty and students and participated in seminars and conferences held at the Institute. He greatly enjoyed the company of young researchers. He attended dinners hosted by the students, and discussed their research work with deep interest and made valuable suggestions. Thus his presence served to generate new enthusiasm for prehistoric research among the faculty and students of the Deccan College. Desmond's dictum 'soft on theory, hard on facts' became a favourite quote among them.

One of us (KP) would like to recall the personal interest shown by Desmond in his prolonged studies devoted to the Acheulian culture of the Hunsgi valley in the lower Deccan. Although hard pressed for time, Desmond wrote a very encouraging Foreword to the author's monograph on this topic published in 1982. Likewise, in 1982 Betty very carefully read the draft of VNM's lengthy paper 'Climate — a factor in the rise and fall of the Indus Civilization' (later published in the *Frontiers of the Indus Civilization*, edited by B.B. Lal and S.P. Gupta), and made valuable editorial changes.

During his visits to the Deccan College Desmond studied the Palaeolithic collections from Chirki-on-Pravara, Bhimbetka, Hunsgi and other sites. In 1982 he visited Didwana in Rajasthan and saw VNM's Palaeolithic excavations at 16R sand dune site and at Singvi Talav and at Koliya-ka-Dhani, both preserving Acheulian and Middle Palaeolithic artefacts. He also taught stone tool knapping to the members of excavation team on the Jayal gravel ridge. Whether in Pune or in the field, Desmond willingly put up with the strong heat and modest amenities. Both Desmond and Betty enjoyed the Indian vegetarian food. They continued to take interest in the progress of the Institute's research and teaching programmes till the last years of their lives.

As to the actual field investigations in India, Professor G.R. Sharma of Allahabad University met Desmond at the Deccan College in 1978 and invited him to conduct joint field research in Central India. From 1980 to 1982 Desmond collaborated with Professor Sharma and his younger colleagues like Professor V.D. Misra, Dr. J.N. Pal and others. Desmond brought with him his own team comprising Dr. Martin Williams (an Australian geomorphologist who had earlier worked with him in North Africa) and several young American workers. This collaborative research between the Allahabad and Berkely teams basically centered in the Son and Belan valleys of northern Madhya Pradesh and southern Uttar Pradesh. It elevated Central Indian Stone Age research over and above concern with stratigraphical sequences and typology of lithic assemblages. It gave importance to geomorphological and palaeoenvironmental reconstructions and investigation of *in situ* or primary Stone Age occurrences. This field research was not only accomplished in great detail but published very promptly in the form of many research articles and one monograph entitled *Palaeoenvironments and Prehistory in the Middle Son Valley*, which was brought out in 1983 under the joint editorship of G.R. Sharma and J.D. Clark.

This collaborative research forms an important chapter in the Stone Age research of post-independence India. Apart from systematic regional survey and excavation including point plotting of objects and features found on exposed surfaces, it employed ethnographic and experimental approaches for reconstructing the Indian Stone Age societies. Reconstruction of a detailed sequence in the Quaternary alluvial sediments of the Son Valley, recognition of various Stone Age habitation deposits at Baghor I,II and III, Patpara, Sihawal, Nakjhar Khurd, and Ghagharia rock shelter I, identification of a Late Palaeolithic shrine-like structure of stone rubble at Baghor II, and radiometric dating of sites are the major contributions of this joint work.

All those who came in contact with Desmond and Betty will recall with gratitude their personal charm and warm hospitality. It mattered nothing to them whether their associates, colleagues and students were from Europe and America or from Afro-Asian countries. All of them received excellent treatment. Both of us were Senior Fulbright Fellows at Berkeley (VNM in 1984 and KP in 1986) and Desmond and Betty were our hosts. We were always overwhelmed by their kindness and hospitality. Besides frequent dinners at their residence which enabled us to meet several archaeologists and anthropologists, they took us for outings on more than one occasion. It was a great pleasure to stay for a few days with them in their log house (cabin as they called it) located in the California forest, not far from the Pacific coast. While strolling on the Drake's beach Desmond and KP found one day a huge, well-shaped log of wood washed ashore. They carried it shoulder to shoulder for a few hundred metres. After loading it in the car, they both heartily laughed that archaeology was indeed a matter of adventure, discovery and hard labour!

The oft-quoted observation that behind every successful man there is a sacrificing and caring wife is true in every bit in Betty's case. She was not only a constant companion to Desmond in his numerous field trips to different parts of the world but rendered academic assistance to him by editing manuscripts and by preparing excellent drawings of various kinds of objects. Desmond himself conceded Betty's contribution by stating that "... what I have been able to do in archaeology has been essentially a team effort by the two of us and, if it had not been for her input, it would not have been possible to do half of what we have managed to do between us..." (Clark 1986: 181).

Desmond promoted the interests of prehistory by organising seminars and conferences on many occasions. Attention must be drawn in particular to the role he played in holding various sessions of the Pan-African Prehistory Congress, International Union of Prehistoric and Protohistoric Sciences, and the organisation of the famous Wenner-Gren Foundation supported conference in Austria in 1965 on the African Later Tertiary and Quaternary periods, leading to the publication of a massive volume entitled *Background to Evolution in Africa* (edited by Desmond jointly with W.W. Bishop). He also raised grants at the international level to establish a laboratory-cum-repository in Addis Ababa (Ethiopia) for materials excavated from Stone Age sites.

During his long career Desmond received many awards and honours such as the Huxley Medal of the Royal Anthropological Institute (London), Gold Medal of the Society of Antiquaries (London), D.Sc. degree of Cambridge University and Fellowship of the California Academy of Sciences. He was an elected Fellow of many distinguished academic bodies and societies such as the British Academy, American Academy of Arts and Sciences and the Royal Society of South Africa. On the eve of his retirement from teaching position at Berkely, his friends and admirers organised an international symposium in 1986 entitled "The Longest Record: The Human Career in Africa". VNM had the privilege of being invited as a participant in it. The proceedings of this symposium were published as part of Volume 16 of *Journal of Human Evolution* (1987).

In 1982 Desmond included VNM as a member of the multinational team which he led to Ethiopia for the search of Early Man. This team reached Ethiopia but, unfortunately, due to political reasons it was not allowed to go to the field for actual investigations. In 1991-92 at a fairly advanced age Desmond led an expedition to the New Guinea highlands, and landed on the high plateau by a helicopter under thick cloud cover with poor visibility. He made a video of the New Guinea aborigines, particularly their stone knapping procedures.

Desmond's own summation of his long encounter with the African Stone Age and peoples will continue to inspire students of prehistory the world over for many years to come: "For me, it has been in part the excitement of learning more about the human past in the continent where it all began — the exhilaration of discovery and excavation of new sites for their confirmation of what we already know or for what they can add to it and the sheer joy of walking and working in a part of the world that has not really changed all that much, so far as vegetation and some animal communities are concerned, since the late Miocene. *Plus ça change, plus c'est la même chose*, for we can see here the kinds of processes, physical and intellectual, and material ways of doing things that can be the clues to more realistic and reliable understanding of the past" (Clark 1986: 188). Etched too in our memory will be the figures of Desmond with his benign countenance and Ho chi Minh beard and Betty with her walking stick and always an encouraging word or two for you on the lips.

Desmond wrote or edited about 20 books, reports and monographs and published over 250 research articles and papers in various scientific journals. A select list of these writings is provided below:

Major Books, Monographs and Edited Volumes

1950. *The Stone Age Cultures of Northern Rhodesia*. Cape Town: The South African Archaeological Society.

1954. *The Prehistoric Cultures of the Horn of Africa*. London: Cambridge University Press.

1959. *The Prehistory of Southern Africa*. Harmondsworth: Penguin Books.

1963. *Prehistoric Cultures of Northeast Angola and Their Significance in Tropical Africa*. Lisbon: Muse do dundo.

1967. *The Atlas of African Prehistory*. Chicago: University of Chicago Press.

1967 (jointly edited with W.W. Bishop). *Background to Evolution in Africa*. Chicago: University of Chicago Press.

1969. *The Kalambo Falls Prehistoric Site*, Volume I. London: Cambridge University Press.

1974. *Kalambo Falls Prehistoric Site*, Volume II. London: Cambridge University Press.

1982 (Ed.). *Cambridge History of Africa*, Volume I. Cambridge: Cambridge University Press.

1984 (jointly edited with S.A. Brandt). *From Hunters to Farmers: The Causes and Consequences of Food Production in Africa*. Berkeley: University of California Press.

2000 (jointly edited with Jean de Heinzelin, Kathy D. Schick and W. Henry Gilbert). *The Acheulean and the Plio-Pleistocene Deposits of the Middle Awash Valley, Ethiopia*. Tervuren (Belgium): Musee Royal De l' Afrique Centrale.

2001. *Kalambo Falls Prehistoric Site*, Volume III. Cambridge: Cambridge University Press.

Major Publications dealing with Indian Prehistory

1983 (jointly edited with G.R. Sharma). *Palaeoenvironments and Prehistory in the Middle Son Valley, Madhya Pradesh, Central India.* Allahabad: Abinash Prakashan.

1983 (jointly edited with J.M. Kenoyer, J.N. Pal and G.R. Sharma). An Upper Palaeolithic Shrine in India? *Antiquity* 57: 88-94.

1986 (jointly with M.A.J. Williams). *Palaeoenvironments and Prehistory in North-Central India: A Preliminary Report*, in Jerome Jacobson (Ed.), Studies in the Archaeology of India and Pakistan, pp. 19-41. New Delhi: Oxford and IBH Publishing Co.

1990 (jointly with M.A.J. Williams). Prehistoric Ecology, Resource Strategies and Culture Change in the Son Valley, Northern Madhya Pradesh, Central India. *Man and Environment* 15: 13-24.

K. Paddayya and **V.N. Misra**
Department of Archaeology
Deccan College
Pune 411 006

Report on Environmental Magnetism Workshop held on April 28, 2003 at the Indian Institute of Geomagnetism, Navi Mumbai

A one-day workshop on "Environmental Magnetism" was held on April 28, 2003 at Indian Institute of Geomagnetism (IIG), Navi Mumbai on the occasion of the handing-over of equipment from the Alexander von Humboldt Foundation, Germany to IIG's Environmental Magnetism Laboratory (EML) headed by Dr. Nathani Basavaiah. The equipment was formally handed over to the Institute by Ms. Gerda Winkler, Deputy Consul General of Germany, Mumbai on April 15, 2003. The EML was initially set up with some basic magnetic measurement equipment at the Colaba campus in 1996. The equipment donated by the Humboldt Foundation included a Spinner Magnetometer and a Thermal Magnetic Susceptibility System for measurements in the temperature range of –200 °C to +800 °C. Along with a AF Demagnetiser, Dual Frequency Magnetic Susceptibility Meter and Pulse Magnetiser, the EML at the Indian Institute of Geomagnetism (IIG), Navi Mumbai has state-of-the-art facilities to carry out sophisticated environmental mineral magnetic experiments.

The inaugural function was chaired by Prof. G.S. Lakhina, Direcotr, IIG who set the tone for the workshop by giving a popular science talk on 'Space Weather'. This was followed by keynote addresses by Mr. J.L. Narasimham, ONGC, Mumbai, Prof. K.V. Subbarao, IIT, Powai and Prof. R.N. Nagarajan, TIFR, Mumbai.

The scientific/technical session that followed the handing-over ceremony included the presentation of ten papers and was jointly coordinated by Drs. N. Basavaiah (IIG, Navi Mumbai) and A.S. Khadkikar (Agharkar Research Institute, Pune). The participants included Scientists from IIG, Tata Institute of Fundamental Research (TIFR), Indian Institute of Technology (IIT) Powai, Bhabha Atomic Research Centre (BARC), Agharkar Research Institute (ARI), Pune, Deccan College, Pune, Oil and Natural Gas Corporation (ONGC) and M.S. University of Baroda.

The papers presented covered various aspects of palaeoclimatology and environmental magnetism. Many case studies and theoretical/experimental approaches were put up to workshop participants for a close scrutiny. The scientific session highlighted the practical importance and significance of mineral magnetic measurements in supplementing other traditional techniques of sedimentology, micropalaeontology and palynology.

Prof. S.N. Rajaguru (Deccan College, Pune) brought out the importance of field investigations in Quaternary climate and geoarchaeological studies providing examples from parts of India, Nepal and Israel. He illustrated various field evidence of environmental changes and palaeomonsoon changes that were reflected in the formation of palaeosols, fluvial landforms and desert dunes and playas. He also briefly showed interrelationship between prehistoric cultures and climatic changes in western India.

Dr. N. Basavaiah (IIG, Panvel) gave an overview of the research that has been carried out using mineral magnetism from various parts of India. Notably, was the recognition of the Younger Dryas cold event from proglacial lake deposits of Garbyang, Higher Central Himalaya. Other sites being studied across India included Lonar Lake, Gulfs of Kachchh and Cambay, coastal deltas and mangroves and playas of the Thar Desert. He emphasized how mineral magnetic properties can be gleaned from the Indian Lake sediments to understand the past climates.

Prof. K.V. Subbarao (IIT-Powai) highlighted the importance and utility of magnetic susceptibility studies of the Deccan Trapp basalts and associated laterites which act as a principal source of sediment for most of the sites that are being studied from a palaeoclimatic perspective of northern Deccan. He also lucidly explained the importance of mineral properties in environmental magnetism studies.

Prof. Nagarajan (TIFR, Mumbai) introduced the principles and applications of Moessbauer spectroscopy. The importance of this technique in elucidating magnetic mineralogy, oxidation state of iron in magnetic minerals and its immense scope in geology was discussed.

Dr. D.A. Sant (M.S. University of Baroda) presented results of granulometric and archaeological studies in the Mahi and Sabarmati river basins. The study encompassed a multiproxy approach using sediment grain size and environmental magnetism. This study has been taken up on continental deposits towards erecting a very high-resolution record covering at least the past 20,000 years.

Prof. M.D. Kajale (Deccan College, Pune) gave an overview of the achievements made on the study of salt lakes of the Thar Desert. He discussed the environmental and geographical context of such lakes and their importance as archives of climate change.

Dr. M. Chaugaonkar (BARC, Mumbai) discussed the theory behind luminescence dating, issues regarding the nature of sample to be taken for such exercises. He presented recently obtained TL dates on a fossil dune near Jaipur in Rajastahn.

Dr. K.P.N. Kumaran (ARI, Pune) drew attention to a much-neglected ecosystem of mangroves. This coastal ecosystem provides ideal sites for palaeoenvironmental reconstruction due to the unique trapping mechanism of mangrove root systems.

Dr. C. Rajshekhar (ARI, Pune) provided a succinct introduction to formaminifera, their ecology and use in palaeomonsoon reconstruction. Recent results from Navlakhi, Gulf of Kachchh on the distribution of salt marsh formaninifera and initial mineral magnetic studies were discussed.

The session concluded with a lecture by Dr. A.S. Khadkikar (ARI, Pune) on the usefulness of remote sensing based geomorphological studies in coastal regions towards understanding environmental change. He highlighted the need for such approaches prior to palaeoclimatic studies for site selection and towards understanding the relationship between sea level and climate change using the example of the lower Sabarmati river basin.

After the technical/scientific session, a panel discussion comprising Drs. G.S. Lakhina, K.V. Subbarao, S.N. Rajaguru, C. Rajshekhar and D.A. Sant was held. The panel unanimously recommended a multidisciplinary and multi-institutional investigation of meteoric impact lake of Lonar in Buldana district of Maharashtra. It was felt that Lonar lake study could adequately fill the gap in our knowledge of palaeomonsoons from Central and Eastern India. It was also unanimously resolved to explore the possibility to bring out a special volume on multidisciplinary and multi-institutional studies started by this laboratory.

B.C. Deotare and N. Basavaiah
Department of Archaeology
Deccan College
Pune 411 006

Indian Society for Prehistoric and Quaternary Studies

c/o Department of Archaeology, Deccan College, Pune 411006.

Report of the General Secretary for 2002-2003 (01-04-2002 to 31-03-2003)

The functioning of the Society during the year ending on 31-3-2003 has been quite satisfactory, both academically and financially. The regular activities of the Society were carried out successfully. The financial position is reasonably sound because of the interest accruing on the fixed deposits and annual grant for the publication of the Society's Journal *Man and Environment* as well as for organizing the annual conference from the Indian Council of Historical Research. We are grateful to Indian Council of Historical Research for financial support. An Audited Statement of the Accounts of the Society for the year is appearing in this issue of the Journal.

Man and Environment

This is the twenty-eighth year of the publication of the Journal and sixteenth year of its biannual publication. Members may have noticed that the last two issues of the journal, Vol. XXVII 1&2, had a face lift with colour printing. The Journal has maintained its standard and continues to attract a wide range of manuscripts by scholars from within and outside the country. The circulation of the Journal is steadily increasing. As the cost of printing has increased considerably over the last few years, the Executive Committee of the Society at its meeting held at the Deccan College, Pune on 22-02-03 unanimously decided to increase the price of the journal from Rs. 400 to Rs. 600/- from volume XXVII No. 2.

We sincerely thank Mr. Sujit Patwardhan and his staff of Mudra Press, Pune for their excellent cooperation in the production of the Journal.

ISPQS Monograph Series 3

The Society is also engaged in the publication of monographs. The Society will publish its third monograph, *Prehistoric Contacts between South Asia and Africa: The Dispersal of Plant Cultivars along the North Indian Sea Board*, edited by V.N. Misra and M.D. Kajale very shortly. This monograph too will be available to the Society's members at discounted price.

Annual Conference

The XXX Annual Conference was held, in conjunction with the XXXVI Annual Conference of the Indian Archaeological Society, XXVI Annual Conference of the Indian History and Culture Society, and the seminar on Maritime Heritage of India at the State Institute of Archaeology, Art History, Conservation and Museology at Hill Palace Tripunithura, Ernakulam, Kerala on 19 to 22 December, 2002.

The following life members of the Society participated in the conference:

R.C. Agrawal, P.K. Behera, K. Bhan, Banani Bhattacharya, R.S. Bisht, Subrato Chakrabarti, D.K. Chauhan, Parth Chauhan, Kurush Dalal, Rhea Mitra-Dalal, Abhijit Dandekar, Michael Danino, P.P. Dandwate, Sushma Deo, P. Binodini Devi, K.N. Dikshit, Y.S. Farswan, Tejas Garge, M.C. Gupta, Sunil Gupta, S.P. Gupta, P. P. Joglekar, P.S. Joshi, Ismail Kallelu, Kalini Khandwalla, B.M. Khanduri, Ravi Korisettar, Arun Kumar, Giriraj Kumar, Manoj Kumar Kurmi, K. Madhavi, Mala Malla, M.L. Meena, Anup Mishra, V.D. Misra, V.N. Misra, R.K. Mohanty, P. Arati Deshpande-Mukherjee, Abdul Munaf, Jayshree Mungur, Veena Mushrif, Malti Nagar, Jitendra Nath, J.N. Pal, Ramesh Kumar Pancholi, Shanti Pappu, Ambika Patel, M.D. Pathak, Anil Pokharia, Arakhita Pradhan, Jacob Jai Raj, M.D.N. Sahi, P.M. Saklani, K.S. Saraswat, R.K. Sharma, K.S. Shukla, Anop Kumar Singh, Manoj K. Singh, Purushottam Singh, Chanchala Srivastava, A. Sundara, Ajoy Kumar Sinha, V.H. Sonawane, Devi Prasad Tewari, P.K. Thomas, D.N. Tripathi, Sila Tripati, Vibha Tripathi and T.P. Verma.

Inaugural Function

The inauguration of the joint Annual Conference of the Indian Archaeological Society, Indian Society for Prehistoric and Quaternary Studies, Indian History and Culture Society and the National Seminar on Maritime Heritage of India was held at 10.30 am, on 19 December, 2002 at the Hill Palace Campus, Tripunithura Ernakulam. Shri Sikander Bakht, His Excellency, Governor of Kerala inaugurated the Conference. Shri T.M. Jacob, the Hon'ble Minister for Water Resources, Archaeology, Archives and Museums, Government of Kerala gave the Presidential Address and Prof. K.V. Thomas, Hon'ble Minister for Tourism and Fisheries, Government of Kerala gave the Keynote Address.

Presidential Address

The Presidential Address of the Society was delivered by Professor Purushottam Singh on *Recent Advances in the Archaeology of the Middle Ganga Plain*, which is published in this issue of *Man and Environment* (XXVIII No. 1).

Professor H.D. Sankalia Memorial Lecture

The Twelfth Professor H.D. Sankalia Memorial Lecture was delivered by Shri M.C. Joshi on *Tradition in the Context of Antiquity in India.* It will be published in the next issue of *Man and Environment* (XXVII, 2).

Professor H.D. Sankalia Young Archaeologist Award

The following two papers were presented for this Award:

1. Manoj Kumar Kurmi: An Analytical View on Harappan Gems.
2. Ambika Patel: Iron from Early Historic Context of Gujarat — A Technological Perspective.

These papers were sent to three eminent experts for their evaluation. After presentation at the Conference, the panel of judges nominated by the Society's Executive Committee, namely Dr. R.C. Agrawal, Prof. V.D. Misra and Prof. Purushottam Singh, unanimously recommended the paper by Ambika Patel for the Professor H.D. Sankalia Young Archaeologist Award, which is published in this issue of *Man and Environment.*

The academic sessions of the conference were held from the afternoon of 19 to 22 December and following papers were presented at the Conference:

S. Pappu, M. Taieb, Y. Gunnell, J-P. Brugal, K. Anupama, R. Sukumar and Kumar Akhilesh:

Excavations at the Palaeolithic Site of Attirampakkam, Tamil Nadu (2002).

S.G. Deo, Sheila Mishra, Sonali Naik, Savita Ghate, S.N. Rajaguru and Prabodh Shirvalkar:

On the Problem of Antiquity of Acheulian Site of Saswad, District Pune, Maharashtra: A Geoarchaeological Study.

Parth R. Chauhan: Geoarchaeology of a Soanian Factory Site.

Jacob S. Jaya Raj and Shaikh Abdul Munaf: Early Stone Age Hunter-gatherers of Jinkalamitta, East Coastal India.

Giriraj Kumar: Discovery of Palaeolithic Cupules from the Archaeological Excavations at Daraki-Chattan-2002.

M.D. Pathak: The Documentation of Rock Art of Pachmarhi Biosphere.

Kuldeep Bhan and Dakshyini Gowda: Shell Working at Nagwada (North Gujarat) with Special Reference to Shell Industries of Harappan Tradition in Gujarat.

V.H. Sonawane, P. Ajithprasad, K.K. Bhan, K. Krishnan, S. Pratapchandran and Abhijit Majumdar: Excavation at Bagasra 2001-2002: A Preliminary Report.

V.N. Misra: Radiocarbon Chronology of Balathal, District Udaipur, Rajasthan.

K.S. Saraswat: Agricultural Economy at Neolithic-Chalcolithic Senuwar (ca. 2200-600 B.C.), District Rohtas, Bihar.

K.S. Saraswat and Anil K. Pokharia: A Pivotal Botanical Evidence of Pre-Columbian Contact between Asia and America.

P.K. Behera: Hikudi: A Neolithic Settlement of Early Second Millennium B.C. in the Middle Mahanadi Valley, Orissa.

Ismail Kallelu: New Light on the Megalithic Culture of Vidarbha.

Ravi Korisettar: A Megalithic Sarcophagus from Kudatini Ashmound.

D.P. Tewari: Excavation at Pirvitani-Sarif, Trilokpur District Bahraich, U.P.

S.R. Walimbe and P.S. Joshi: Excavations at the Early Historic Site of Kahali-Brahmapuri, District Chandrapur (Maharashtra).

R.K. Mohanty: Recent Excavations at Mahurjhari, Vidarbha, Maharashtra.

Anup Mishra and U.P. Arora: Excavtions at Painted Grey Ware Site of Abhaipur 2001-2002, District Pilibhit, U.P.

Arati Deshpande-Mukherjee: Reconstruction of Marine Shellfish Exploitation Patterns at Kelshi on the Konkan Coast of Maharashtra.

P.P. Joglekar and S.G. Deo: Building of an Archaeological Information System (AIS): A Few Preliminary Considerations.

Sila Tripati: Exploration and Excavation of Shipwrecks in Indian Waters: An Overview.

A.S. Gaur and Sundaresh: Onshore Excavation at Bet Dwarka Island.

Veena Mushrif-Tripathy: A Bio-cultural Explanation of Maxillary Sinusitis.

Y.S. Farswan and Jaibir Singh: Effects of Induced Feeding on Trace Element Profile of Himalayan Goat (*Capra jharal*).

P.P. Dandawate and B.S. Gajul: Temple Complex at Palasdev, District Pune, Maharashtra.

Abhijit Dandekar and Rukshana Nanji: Pottery from Sanjan: Preliminary Observations.

Arun Kumar: Significance of Sacred Cultural Traits among the Gonds of Bastar, Chhattisgarh.

Anop Kumar Singh: Archaeology of Rai Bareli District.

Dinesh Kumar Chauhan and Anop Kumar Singh: Archaeological Exploration in Bindki Tehsil of Fatehpur District of Uttar Pradesh.

Kalini Khandwalla: Preservation of India's Archaeological Heritage through Archeologists-Public Interaction: Issues and Strategies.

Madan Lal Meena and Murari Lal Sharma: "Uttaar-Purvi Rajasthan Ki Shail Chitrakata- Ak Adhyan".

R.K. Pancholi: "Dar Ki Chattan Ke Hastaswaghat Pura Kala Ke Aadi Sanket".

New Life Members

The following persons joined the family of life members of the Society during 2002-2003:

Bina Gandhi Deori, Aokumla Walling, Jayshree Mungar, Anil Pokharia, Kumar Akhilesh, Sharda Srinivasan, Subhash Khamari, Anuja Jagdish Geetali, Sandeep Singhal, Shilpa Sandeep Gore, Sangeeta Kalaskar, Priyadarshi Khobragade, Anita Rane-Kothare, Jayshree Nair and Smita Surebankar

Meeting of the Executive Committee

Minutes of the Meeting of the Executive Committee

A meeting of the Executive Committee of the Society was held in the State Institute of Archaeology, Conservation, Art History and Museology, Hill Palace, Tripunithura, Ernakulam Kerala, on Sunday the 22nd December, 2002. The meeting was presided over by the General Secretary, P.K. Thomas. The following members were present:

Prof. R.K. Sharma, Dr. P.K. Thomas, Dr. P.P. Joglekar, Dr. P.S. Joshi, Dr. Arati Deshpande-Mukherjee, Dr. S.G. Deo, Dr. Malti Nagar, Dr. R.K. Mohanty, Dr. K.S. Saraswat, Dr. K. Rajan.

Prof. V.N. Misra, Dr. R.C. Agrawal, Dr. B.C. Deotare, Dr. K. Krishnan, Dr. Sadashiba Pradhan, Dr. Sheila Mishra, Dr. Sila Tripati, Dr. R.N. Singh, Dr. Sunil Gupta, Dr. S.F. Wadia were unable to attend the meeting.

At the outset, the General Secretary, Dr. P.K. Thomas, welcomed the members. He apprised the Committee about the major activities of the Society during 2001-2002. These included details of the 29th Annual Conference held at the Maharaja Sayajirao University of Baroda, Vadodara, Gujarat on 22-24 November 2001, and publication of Vol. XXVI(2) of *Man and Environment*. He also apprised the Committee of the details of the audited statement of Society's income and expenditure during 2001-2002, which is printed in *Man and Environment* XXVII(2). The Society's financial situation remains reasonably good.

Meeting ended with a vote of thanks to the Chair.

Meeting of the General Body of the Society

The General Body meeting of the Society was held at the State Institute of Archaeology, Hill Palace, Tripunithura, Ernakulam on 22nd December 2002.

The following members were present.

R.C. Agrawal, P.K. Behera, K. Bhan, Banani Bhattacharya, R.S. Bisht, Subrato Chakrabarti, D.K. Chauhan, Parth Chauhan, Kurush Dalal, Rhea Mitra-Dalal, Abhijit Dandekar, Michael Danino, P.P. Dandwate, Sushma Deo, P. Binodini Devi, K.N. Dikshit, Y.S. Farswan, Tejas Garge, M.C. Gupta, Sunil Gupta, S.P. Gupta, P. P. Joglekar, P.S. Joshi, Ismail Kallelu, Kalini Khandwalla, B.M. Khanduri, Ravi Korisettar, Arun Kumar, Giriraj Kumar, Manoj Kumar Kurmi, K. Madhavi, Mala Malla, M.L. Meena, Anup Mishra, V.D. Misra, V.N. Misra, R.K. Mohanty, P. Arati Deshpande-Mukherjee, Abdul Munaf, Jayshree Mungur, Veena Mushrif, Malti Nagar, Jitendra Nath, J.N. Pal, Ramesh Kumar Pancholi, Shanti Pappu, Ambika Patel, M.D. Pathak, Anil Pokharia, Arakhita Pradhan, Jacob Jai Raj, M.D.N. Sahi, P.M. Saklani, K.S. Saraswat, R.K. Sharma, K.S. Shukla, Anop Kumar Singh, Manoj K. Singh, Purushottam Singh, Chanchala Srivastava, A. Sundara, Ajoy Kumar Sinha, V.H. Sonawane, Devi Prasad Tewari, P.K. Thomas, D.N. Tripathi, Sila Tripathi, Vibha Tripathi and T.P. Verma.

The meeting was presided over by Prof. Purushottam Singh, President of the Society.

The following business was transacted at the meeting.

The report of the activities of the Society for the year 2002-2003 was presented by P.K. Thomas, General Secretary of the Society. It was unanimously approved by the members of the Society.

The Annual Audited Statement of the Accounts for the year 2001-2002 was placed before the General Body by the General Secretary, and it was unanimously approved by the members present.

President of the Society for 2002

Dr. P.K. Thomas proposed the name of Dr. R.S. Bisht, Director of Exploration and Excavations, Archaeological Survey of India, New Delhi as President of the Society for the next year. The proposal was unanimously accepted by the members present.

Professor H.D. Sankalia Memorial Lecturer

Professor V.N. Misra proposed the name of Professor A. Sundara, former Head of the Department of Archaeology, Dharwad University, Karnataka and former Director, Karnataka University Post-Graduate Centre, Bijapur, Karnataka as Professor H.D. Sankalia Memorial Lecturer for 2003. The proposal was unanimously approved by the members present.

The 2nd Professor R.K. Sharma Award for Excellence in Archaeology

In recognition of the valuable contribution made by Prof. B.B. Lal to Indian Archaeology, over a period spanning more than sixty years, the General Secretary proposed his name for the second Professor R.K. Sharma Award. The proposal was unanimously accepted by the Committee. The Award will be presented to Professor Lal at the forthcoming Annual Conference of the Society at Venkeswara University, Tirupati, Andhra Pradesh.

The meeting ended with a vote of thanks to the Chair.

20-07-2003

(P.K. Thomas)
General Secretary

INDIAN SOCIETY FOR PREHISTORIC AND QUATERNARY STUDIES

c/o Department of Archaeology, Deccan College, Pune 411 006

BALANCE SHEET AS ON 31st MARCH 2003

Funds and Liabilities	**Rs.**	**Rs.**	**Properties and Assets**	**Rs.**	**Rs.**
Trust Funds or Corpus Bal. as per prev. B/S	672,043.40		Immovable Properties (As per Schedule)		
Ajustment during the year			Bal. as per prev. B/S	00.00	
(Donations recd. during the year)	00.00	672,043.40	Add: During the year	00.00	
			Less: Sold during the year	00.00	
Other Earmarked Funds —	83,607.95		Less: Depreciation @ 5%	00.00	00.00
(Created under the provisions of the trust					
deed or scheme or out of the income)			Investments (As per Schedule II)		1,712,355.56
Depreciation fund	00.00				
Sinking fund	00.00		Other Movable Properties		94,938.12
Reserve fund	1,016,035.45	1,099,643.40	(As per Schedule III)		
			Bal. as per prev. B/S.	00.00	
Loans (Secured/Unsecured)			Add: During the year	00.00	
(As per schedule)			Less: Sold during the year	00.00	
For expenses	00.00		Less: Depreciation @ 5%	00.00	
For Advance	00.00	00.00	Loans (Secured and Unsecured)	00.00	
			Loans Scholarships	00.00	
For rent and other deposits	00.00		Other Loans	00.00	
Audit fee	2,200.00		Cash & Bank balances	00.00	00.00
Provision for Contribution	788.94	2,988.94			
Income & Expenditure A/c.			Income Outstanding		
Bal. as per prev B/S	00.00		Rent, Interest, Other Income	00.00	
Less: Appropriation if any	00.00		Cash	127.48	
Add: Surplus of Inc & Exp A/c.	112,065.93	112,065.93	Bank Balances	63,434.97	
			Amounts Receivable	15,885.54	79,447.99
			Income & Expenditure A/c.		
			Bal. as per prev. B/S	00.00	
			Add: Deficit for the year	00.00	00.00
Total Rs.		1,886,741.67	Toral Rs.		1,886,741.67

As our report of even date

FOR A.S. CHANDVANKER & CO., CHARTERED ACCOUNTANTS

Date: 16.08.2003
Place: PUNE

A.S. CHANDVANKER

(P.K. Thomas)
GENERAL SECRETARY

(P.P. Joglekar)
JOINT SECRETARY

(Arti Deshpande-Mukherjee)
TREASURER

INDIAN SOCIETY FOR PREHISTORIC AND QUATERNARY STUDIES,

c/o Department of Archaeology, Deccan College, Pune.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31st MARCH 2003.

Expenditure	Rs.	Rs.	Income	Rs.	Rs.
To Expenditure in respect of			By Rent* (Accrued/Realised)		00.00
Properties	00.00				
Rent, Taxes, Cases	00.00		By Interest* (accrued/realised)		
Repairs and Maintance	00.00		On Securities	00.00	
Salaries	00.00	00.00	On Deposits	147,606.16	
			On Loan	00.00	
			On Bank Account	4,760.00	152,366.16
To Expenses on the object of the trust			By Donation in cash or kind		00.00
(As per Schedule A)			By Conference Grant		90,000.00
Conference Expenses	93,915.50		By Publication Grant – ICHR		36,000.00
Publication Expenses	190,086.00		By Cost of Monographs – DHP etc.		4,995.00
Other Expenses	3,263.02	289,264.52	By Life Membership Fees		28,500.00
To Audit Fees		2,000.00	By Sale of M&E Volume		116,132.00
To Contribution and Fees		00.00	By Transfer from Reserve		00.00
To Depreciation		24,662.71	By Deficit carried over to B/S		00.00
To Amount transferred to Reserve or Specific Fund		00.00			
To Surplus carried over to B/S		112,065.93			
Total Rs.		427,993.16	Total Rs.		427,993.16

As our report of even date

FOR A.S. CHANDVANKER & CO., CHARTERED ACCOUNTANTS

Date: 16.08.2003
Place: PUNE

A.S. CHANDVANKER

(P.K. Thomas)
GENERAL SECRETARY

(P.P. Joglekar)
JOINT SECRETARY

(Arti Deshpande-Mukherjee)
TREASURER